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Compressed Air Magazine

Vol. 43, No. 6 | London - New York - Paris | June, 1938

SUBMARINE BLAST AT SVOLVAER, NORWAY

$1161 INVESTED IN THESE BETHLEHEM TIES

saves $3005 in a year

According to actual experience of Hanna Coal Company.

These 1680 Bethlehem No. 3 Steel Ties represent part of a year's supply for Hanna Coal Company's Willow Grove Mine. They cost $1161. According to coal company figures, they will save, compared to wood ties, $3005 during the coming year. Here is how this figure is arrived at from data supplied by Hanna Coal Company: These ties will be used in rooms which have an average life of 2500 tons. According to careful check, the labor cost of installation and recovery will be seven cents apiece. For wood ties it is double that.

Though wood ties have lower first cost, they can be used only three times, or four at the outside, before spike-killing puts them out of service. In the course of one year, figuring on maximum life, five sets of wood ties are required—at a cost of $1411. One set of steel ties will last the year and make a good start toward another twelve months. Cost, delivered, for steel ties was $1161. Labor, for installing and removing them, will amount to $2352—for wood ties, it would run to $4704 plus $403 for spikes. Net saving—$3005 annually.

Why this saving is possible. Advantages of Bethlehem Steel Mine Ties are these: Labor costs are lower because these ties do not require spiking, gaging, or tie rods. Steel clips, permanently fastened to the tie, hold rails firmly in place, rigidly maintain proper gage. A blow or two with hammer or ax locks the rail in place. Twenty to thirty installations are commonplace with these rugged ties. Track goes in faster, with less cost; once in, it is safer.

BETHLEHEM STEEL COMPANY

ON THE COVER

THE photograph that is reproduced on the cover was taken in the extreme northern portion of Norway during the course of an underwater excavation operation executed by the Norwegian contracting firm of Hoyer-Ellefsen. All the drilling was done with an X-71 drifter drill mounted on a specially designed platform rig.

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IN THIS ISSUE

IN addition to being a magnificent engineering work of great practical value to the Southwest, Boulder Dam possesses singular beauty and gracefulness born of sweeping lines and majestic proportions. Augmenting this inherent attractiveness are embellishments wrought in well-chosen materials in keeping with the artistic traditions of the region. These ornamental and sculptural features are described in our leading article by one of the members of the engineering staff that directed the design and construction of this monumental work.

•

THE tremendous power that is latent in compressed air is being utilized literally to shoot into space airplanes that must be launched at sea. The success with which this is being done has prompted aeronautical engineers to consider using the same scheme to put land planes in flight. Its adoption would permit limiting the size of airports to areas required for safe landings. In addition to the resultant monetary savings, it is apparent that the hazards incidental to long take-off runs would be lessened. Mr R. G. Skerrett tells what is now being done in catapulting planes, and points out the possibilities of the method.

•

IT is contended by certain industrialists and chemists that the soil will grow virtually everything that man requires except metals and minerals, which it already contains. They also hold that the application of scientific methods to the treatment of agricultural products will bring the farmer a greater measure of prosperity than he has ever known. The purpose of one of the first lines of investigation being undertaken by this scientific school is to point out the possibility of developing an industrial-alcohol industry through the utilization of surplus and waste crops. The initial distillery, which has demonstrated that such alcohol can be produced at a cost that is within the competitive range, is described in this issue.

Compressed Air Magazine

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Volume 43 **JUNE, 1938** **Number 6**

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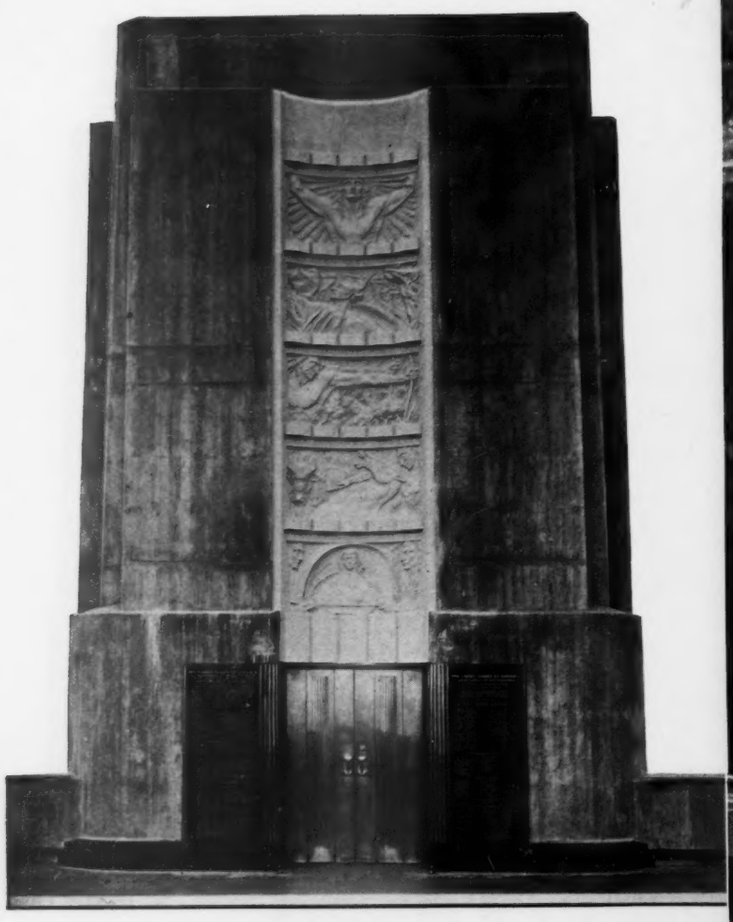
A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

Published by Compressed Air Magazine Company. G. W. MORRISON, president; R. A. LUNDELL, vice-president; F. E. KUTZ, secretary-treasurer.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York, N. Y.
Annual subscription price: domestic, $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index.



Ornamental Features of Boulder Dam

Wesley R. Nelson*

MUCH has been written of the might of Boulder Dam, its multiplicity of purposes, its engineering excellence, its awe-inspiring dimensions; but little has been told of its architectural grandeur, its classic sculpture, its ornamental beauty. One might expect a courthouse, library, or office building to be decorated with mosaic and sculpture; but one is surprised to find so thoroughly a utilitarian structure as a dam and power house embellished in this manner.

Approaching the dam from the downstream face, the eye is caught by the broad sweep of gray concrete between the reddish-black walls of Black Canyon. The eye follows the graceful sweep of the downstream slope to the power-house wings nestling snugly against the foot of the cliffs, hundreds of feet below. Farther downstream, set in the canyon walls, are the cliff-dwellerlike houses of the outlet works from whose ports spout glittering cascades that fall with a roar into the canyon below, the spray rising high in the clear desert air.

Crossing the canyon on the wide crest of the dam between massive parapets, a road leads across a bridge over the Arizona spillway, "ten stories" above the spillway floor, and turns upstream to a vantage point on the Arizona canyon rim. Here unfolds to the gaze a majestic view of the emerald waters of the lake, of the concrete gray of the upstream face of the dam, of the graceful intake towers rising from the lake's surface, of the long sleek lines of the spillway, and, encompassing all, of the red and black rock walls of the desert hills. Directly across the canyon are the long overflow crest, tall piers, and interlying gates of the Nevada spillway. When the reservoir is filled to overflowing, water will

*Chief, Engineering Division Washington Office, U. S. Bureau of Reclamation.

RAMPARTS OF CONCRETE

The crest of the 727-foot wedge of concrete and its environs. In the foreground is the top of one of the two 34-story inlet towers on the Nevada side, with the corresponding Arizona pair in the middle distance. Across the lake is the Arizona spillway, capable of handling an outflow of 200,000 cubic feet of water a second. The triple line of cars gives ample evidence of the width of the dam crest—45 feet. Rising from the downstream face of the dam, at the right, are the two elevator towers and the Arizona utility tower. The picture at the upper left shows the entrance to the Arizona elevator tower. The smooth exterior finish of the concrete was obtained by using plywood forms and by exerting special care in the pouring. Above the doors are five figures in relief that pertain to Indian life. At either side of the doors are bronze plaques bearing the names of Government officials and individuals who were connected with the origin or consummation of the Boulder Dam Project.

pass over this crest into the basinlike channel, then plunge downward 600 feet through an inclined shaft to by-pass the dam through a tunnel leading to the river below the power house.

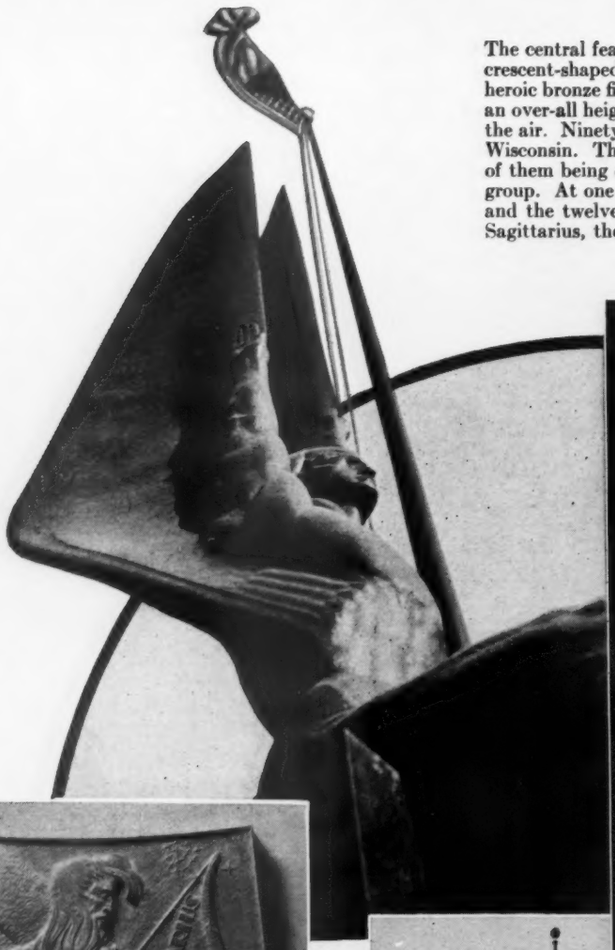
Near the dam and rising from the reservoir are the four intake towers. These are set opposite each other in groups of two, and only a small part of their 34-story height appears above the water's surface. Before the reservoir was filled, these resembled huge fluted columns: now one is impressed by the architectural treatment of each tower with its surmounting hoist house. Aluminum windows are set in the 12-sided edifice, and above these are narrow metal louvers accentuating the vertical lines of the structure. On the domed roof is mounted an ornate lantern. The bridges that connect each pair of towers and link it with the dam mask their strength of steel in molded concrete.

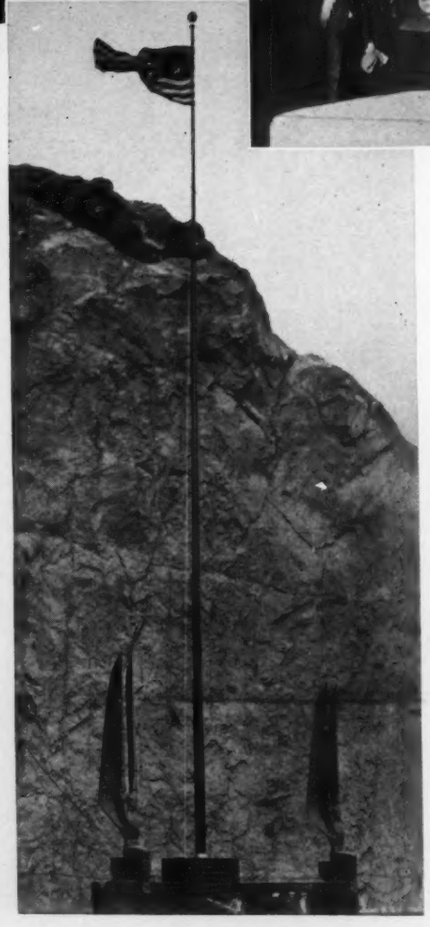
Although they have the appearance of memorial monuments, the towers are useful members and serve to regulate the flow of water from the reservoir. Hoists in the top of each one raise and lower cylindrical gates, 30 feet in diameter and 10 feet high, located at the base of the tower and at a point 150 feet higher up. With these gates in the raised position, the lake water passes through the hollow structures to 30-foot-

AERIAL VIEW OF BOULDER DAM AND LAKE MEAD

FLAGPOLE AND SETTING

The central feature of the traffic safety island on the Nevada side of the canyon is a crescent-shaped base of polished black granite, on either end of which is seated a heroic bronze figure with upstretched wings. They weigh 7,000 pounds each and have an over-all height of 30 feet. Between them, a slender steel flagpole rises 132 feet into the air. Ninety tons of granite for the base was quarried in California and finished in Wisconsin. The bronze figures were cast in New York City. The pictures show one of them being erected, a close view of it in place, and a general view of the flagpole group. At one end of the traffic island on an octagonal dais are a magnetic compass and the twelve signs of the zodiac executed in bronze and terrazzo. The figure of Sagittarius, the Archer, is illustrated.





diameter steel pipes which connect through the medium of gates or needle valves with the power-house turbines or outlet works.

The upstream face of the dam is in the form of a curving wall rising sheer from the water's edge and giving little indication of its great height or of the chasm which lies just beyond. Yet that wall is holding back a weight of water sufficient to settle the earth's crust for 50 miles around—sufficient actually to compress the rock to a measurable degree.

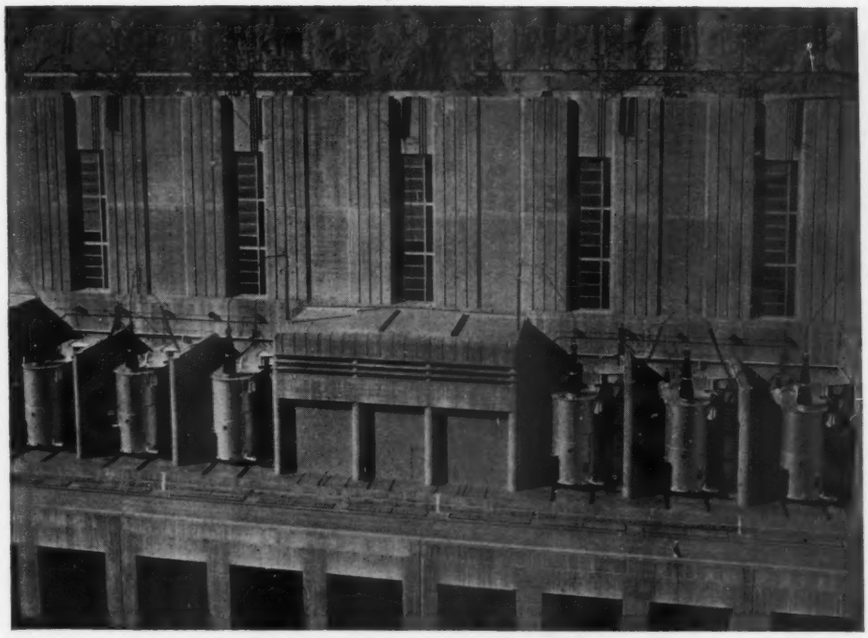
Returning to the dam, one pauses to view the fiord-like lake and the multi-colored scarp of Fortification Hill in the background, then crosses the crest to gaze down the long slope to the power house and the river beyond. Attention is next turned to the towers on the downstream face—to the four pylons which rise from it to a point 34 feet above the crest of the dam. The two nearer the abutments, termed the utility towers, contain rest rooms: the other two are equipped with elevators which descend into the dam and connect with inspection passageways and with galleries leading to the power plant.

The smooth molded form of each of these pylons was obtained by the use of plywood forms and by the exercise of special care in pouring and finishing the concrete. Around the base is a band of gray Colorado granite. The entrance door is of bronze, a rich golden-brown in color. Above the doors of the two elevator towers are panels of artistic reliefs in white concrete. Indian figures dominate the five scenes on the Arizona tower, and this group carries the following inscription:

> **Since primordial times American Indian tribes and Nations lifted their hands to the Great Spirit. From these ranges and plains we now with them in peace buildeth again a nation.**

On the Nevada elevator tower are portrayed in bold relief the five purposes of the dam: Flood control, navigation, irrigation, water storage, and power.

Flanking the doors of the elevators are bronze plaques. In the case of the Arizona tower, one of these bears the names of the



POWER-HOUSE EXTERIOR

A section of the Nevada wing of the power house at the base of the dam, showing the pleasing effect that has been obtained by molding vertical panels and columns in the concrete and by the use of high, narrow windows. At either side is a group of three transformers, and between them is a switch house that contains three oil circuit breakers. The transformers and the rolling doors of the switch house are covered with aluminum paint, while the window sashes and trim are of gleaming aluminum.

presidents of the United States and of the secretaries of the Department of the Interior who were in office during the period of construction, of the Colorado Compact Commission, of the authors of the Boulder Canyon Project Act, and of the administrative and legal staffs of the Bureau of Reclamation. Below this group of names is a brief chronology of the Colorado River development. On the opposite tablet are engraved the names of the principal engineers, designers, field staff, and consultants of the Bureau of Reclamation who participated in the building of the dam. The plaques on the Nevada tower list the names of the principal contractors and give a brief description of the construction features.

Entering the Nevada elevator tower, the terrazzo floor immediately claims attention. Here and throughout the dam and power plant, the decorations in terrazzo follow patterns developed by the southwest Indians for their pottery. The floor design of the tower in question has been taken from a Pima basket. Its colors are black and dull gray. The walls of the lobby are beautifully finished in highly polished black marble, while the ceiling is of gleaming aluminum and conceals lighting units.

A pair of bronze doors at the back of the tower opens, and we enter the 20-passenger elevator. Dropping swiftly and silently, the car stops after a minute's travel 528 feet—44 stories—below the dam crest. Again a pair of bronze doors slides smoothly apart, disclosing another beautiful lobby with cream-colored tile walls and ceiling, black terrazzo baseboards, and a floor ornamented with an Indian design in black and white on a field of red ocher. The floor proper is made of a material containing cream, pink, and green marble chips. From there, a brightly lighted passageway, lined with the same warmly colored tiling, leads downstream through the dam to the power house. At intervals, where doors to floor drains are located, the artist has placed decorations patterned after Indian designs and colors.

Passing through corridors in the central section of the power house, we step on to a balcony at the end of and overlooking one of the long Nevada generator rooms. Four huge generators, each of 115,000 hp., are operating, as indicated by a light surmounting each generator. These units are strikingly painted red and black, and have aluminum bands and railings. Just beyond them, a block distant from the visitors' gallery, are being installed two more generators. Two 300-ton cranes, brightly colored green, move smoothly overhead, their wheels rolling silently on rails set in the walls and running the length of the generator room. Color has been used not only for ornamental purposes in the dam and power plant but also to indicate functions. That is, most of the pipes are concrete gray, but each is marked with a distinctive band, or with a valve painted in a distinctive color, in order to designate its purpose. For example, vermilion is used for high-pressure water pipes and white for all compressed-air lines.

Before returning to the crest of the dam, a visit is paid to the power-house exterior. The route leads through the power-house corridors and downstairs, or the elevators take us to the level of the generator floor. Along the way, our attention is successively attracted by the colorful terrazzo motifs, the bright aluminum doors, the massive architecture, and the decorative details of the hand railings and window casements. Outside of the power house, the "long view" is down the canyon past the cascades from the outlet works and beyond to the red, gray, and black of the desert mountains. Downstream from the plant, the canyon walls rise sheer from the water's edge—500 feet to the rim above. Back of the central portion of the power house the smooth arch of the dam looms high against the blue sky.

The long gray concrete walls of the power-house wings and central section are beautifully molded in vertical panels. At intervals, high narrow windows accentuate the vertical form. Power transformers and oil circuit breakers are erected on a deck along each power-house wall. Each transformer is set in an enclosure about 24 feet square, and between each group of three transformers is a switch house which completely encloses three oil circuit breakers. The huge transformers and the large rolling doors of the switch house are painted in bright aluminum. On the walls of the switch house above the doors are ornamental aluminum strips, and the sashes of the tall windows are of the same metal.

The next point of interest is the safety island at the Nevada abutment of the dam. This traffic island is located at the junction of the main highway across the dam and of the road to the Nevada spillway. It is in the form, roughly, of a rectangle, 100 feet long and 35 feet wide; its floor is a few steps higher than the crest of the dam; and it is rimmed with heavy concrete parapets inclosing benches for the weary traveler. Outlined against the sheer wall of a cliff 100 feet high, constituting virtually a back drop, is the central feature of the island—a crescent-shaped monument 35 feet long and 7 feet high. It consists of two heroic, bronze, winged figures, measuring 30 feet from toes to tips of upstretched wings, seated on blocks of highly polished black granite—one at each end of the crescent—and of a tall, slender flagpole rising from a third block bearing the following inscription on the side facing the dam:

> **It is fitting that the flag of our country should fly here in honor of those men who, inspired by a vision of lonely lands made fruitful, conceived this great work, and of those others whose genius and labor made that vision a reality.**

The black granite for the base, 90 tons of it, was taken from a quarry near San Diego, Calif., and was cut to shape in Cold Spring, Wis. The huge bronze figures, termed by the sculptor "The Figures of the Republic," weigh 7,000 pounds each. They were cast in New York City. The flagpole, of hollow-steel construction and enameled

WALL AND FLOOR DECORATIONS

Walls, floors, and ceilings of the elevator lobbies, of the corridors leading from them, and of the various galleries throughout the dam and power house compare favorably in the attractiveness of their finish with the interior of an office building. Terrazzo floors, of varicolored marble chips, have set in them colorful designs copied from the pottery and baskets of the southwest Indians. Illustrated here are one of the power-house corridors (right), the visitors' gallery overlooking the Nevada generator room (just above), and one of the galleries leading from an elevator shaft through the dam to the power house (upper right). The walls of the latter are faced with warmly colored tile. At the upper left is a small section of the interior of one of the elevator lobbies, with its walls of polished black marble and elevator doors of bronze.

in black, carries the Stars and Stripes 132 feet above the safety-island floor.

At the end of the island, towards the spillway, is an octagonal dais on which is a magnetic compass and the twelve signs of the zodiac executed in bronze and terrazzo. These are in keeping with the safety-island floor, which is noteworthy not only because of its unique and beautiful design but also because of its historical interest and the facts it presents. Boulder Dam was dedicated by President Roosevelt on September 30, 1935. The floor is arranged to show the location of the stars in the northern hemisphere at 9:30 p.m., Pacific standard time, on that date. The sky is represented by black terrazzo, and the 208 principal stars and six star clusters by nickel-silver disks ¼ inch to 4¼ inches in diameter, the size varying with the apparent magnitude or the relative brightness of each. The planets in our solar system which were then visible are marked by 4½-inch bronze disks.

Additional astronomical data are given by a reproduction of the circle of the precession of the equinoxes, using the center of the flagpole as the center of the ecliptic. By reference thereto it will be noted that the North Star was Thuban when the Great Pyramid was built in 3000, B.C., that it was Polaris at the time the dam was dedicated, and that in 14000 A.D. it will be the bright star Vega. At the end of the island, opposite the magnetic compass, is an inscription in bronze letters set in terrazzo briefly describing the floor and presenting astronomical facts and theories as they are known today.

The purpose of all this is to furnish astronomical data for the present generation and for those living in the far distant future, perhaps hundreds of centuries from now, when most of the concepts of our civilization have been obliterated possibly by a cataclysm of nature's or of man's making. Our knowledge of astronomy would have been far advanced if, at the time of the pyramids, some Egyptian king had ordered laid out in stone and bronze a "star chart" of his day.

Another purpose of the floor design is to achieve a pleasing and artistic effect. In this connection it should be mentioned that the pattern of star and sky has been enlivened as well as linked to the project by representations in bronze of the national coat-of-arms and of the shields of the seven states of the Colorado Basin. These are in the floor at the dam side of the island. Blue, white, red, and yellow terrazzo in geometric forms also has been used to relieve the somber tones of the black background.

In the vicinity of Boulder Dam are several bronze memorial plaques. Across the Arizona spillway bridge and facing the bridge and dam, the Federal Government has erected a 7x11-foot tablet in memory of those who died during the construction of the dam. A similar one has been set in the cliff between the dam and the spillway by the American Federation of Labor. On Observation Point, 1½ miles west of the dam, the members of the Third World Power Conference and of the Second Congress of the International Commission on Large Dams have placed a plaque in honor of Dr. Elwood Mead bearing this inscription:

> Dr. Elwood Mead
> Commissioner, Bureau of Reclamation
> Department of the Interior
> 1924-1936
> Whose lifetime work culminated in the construction of the Boulder Canyon project, creating Lake Mead, named in his honor.

The nighttime view of Boulder Dam is as attractive as that under the glittering sunlight. The parapets of the dam, the intake-tower bridges, and the road across the Arizona spillway are provided with lights that illuminate without glare. A lantern of aluminum, 10 feet high, is mounted on the roof of each intake tower. Flood lights at strategic locations illuminate the outlet works, the power house, and the downstream face of the dam. Seen from the air at night, this brightly lighted spot of geometric pattern in the midst of the black encircling desert heights is spectacular.

The engineers, artists, and sculptor have charted new fields in the architecture and decorative features of Boulder Dam. The engineers of the Bureau of Reclamation have always attempted, so far as the strength of materials and the efficiency of operation permit, to make their structures pleasing in appearance. At Boulder Dam they were assisted in the architectural treatment by Consulting Architect Gordon B. Kaufmann, of Los Angeles, Calif.; the designs for the terrazzo floors in the dam and power plant and the color treatment of the machinery were originated by the artist Allen Tupper True, of Denver, Colo.; the reliefs above the tower doors, the flagpole base, the safety-island floor, the memorial tablet near the Arizona spillway bridge, as well as that for Doctor Mead, were designed by the sculptor Oskar J. W. Hansen, of Charlottesville, Va., who also built the plaster models for the reliefs, for the 2-winged figures, and for his plaques. Capt. J. F. Helweg and his staff, at the Naval Observatory in Washington, D. C., calculated the true positions of the stars and planets in the star chart of the safety island.

Boulder Dam was built by the U. S. Bureau of Reclamation of which John C. Page is the commissioner, R. F. Walter the chief engineer, S. O. Harper the assistant chief engineer, and J. L. Savage the designing engineer.

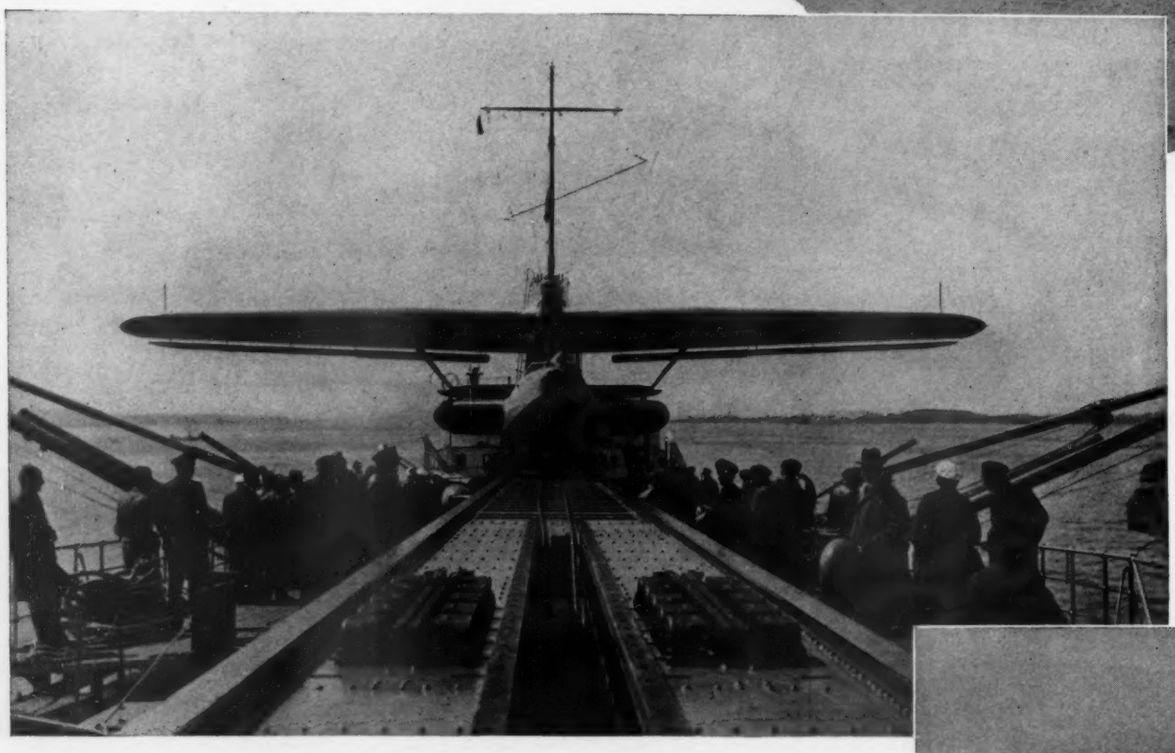
MEMORIAL TO THOSE WHO DIED

Commissioner John C. Page of the U. S. Bureau of Reclamation (center), with Construction Engineer Ralph Lowry (right), and Consulting Sculptor Oskar J. W. Hansen, at the unveiling of a memorial to the men who lost their lives during the construction of the dam. This tablet, which was erected by the Government, is near the Arizona spillway. It measures 7x11 feet. A similar memorial has been erected by the American Federation of Labor, and is set in the side of the cliff between the dam and the spillway. A third commemorative plaque pays homage to Dr. Elwood Mead, Commissioner of the U. S. Bureau of Reclamation from 1924 to 1936, after whom is named the lake created by Boulder Dam. It is on Observation Point, 1½ miles west of the dam.

Catapults May Solve Airport-Space Problem

Robert G. Skerrett

Marine Launching Apparatus Suggested for Use by Huge New Land Planes to Restrict Lengths of Take-Off Runways



LAUNCHING A PLANE FROM A SHIP

The "Ostmark," which serves as a seaplane base on the German air-mail route between Africa and South America is pictured at the top of the page. The vessel is equipped with a derrick to lift planes aboard for servicing and refueling them, and with a catapult for launching them. It is 245 feet long and is powered by two oil engines. Just above is a large ocean-mail flying boat on the runway of the catapult of the "Ostmark." In the foreground are the cables that draw the plane forward and, at either side of the central slot, the air-operated brakes that retard the progress of the carriage after the plane has taken off. At the right is a view from the opposite end of the same runway, showing a plane that has just been successfully shot out into space.

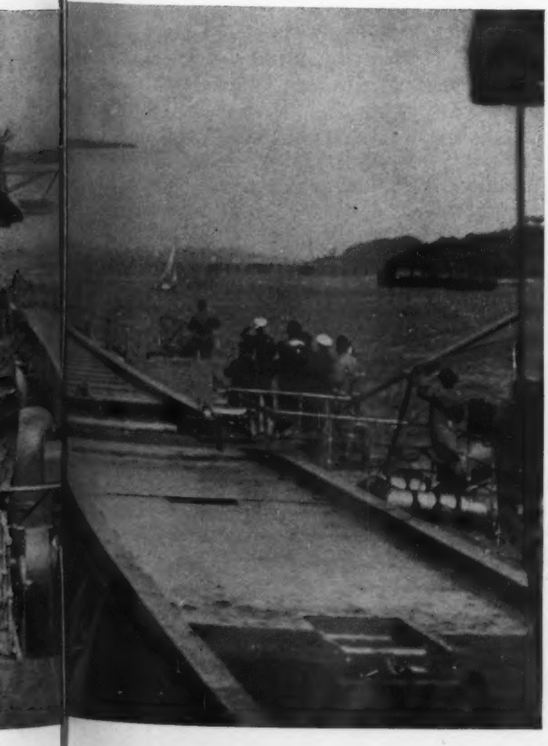
BIGGER and better planes for both overseas and overland services have recently been turned out by plants in this country. Still larger ones are under construction, and plans are in preparation for a type that will far outstrip in size, motive power, and carrying capacity the largest of the machines now in course of fabrication here. Relatively few of us comprehend what all this means.

On December 17, 1903, Orville Wright guided, for the first time, a self-propelled, man-carrying biplane that stayed aloft for 59 seconds and covered the then astonishing distance of 852 feet! That flimsy contraption was equipped with a 12-hp. engine that was designed and built, like the whole machine, by the two Wright brothers. The biplane, loaded, weighed considerably less than 1,000 pounds, flew at a height of not more than 10 feet, and made an overground advance of not quite 10 miles an hour

Courtesy of United Air Lines

PREPARING TO TAKE OFF

A large transport plane taking passengers aboard at the Newark airport before starting a flight. It is lined up on a runway. Only a few years ago planes were of such size that they could take off with a full load in less than 400 feet. Now, however, some of them occasionally have difficulty in getting into the air after the 1,000-foot run that is permitted by the Department of Commerce, with the result that exceptions to the ruling have already been made in some cases.



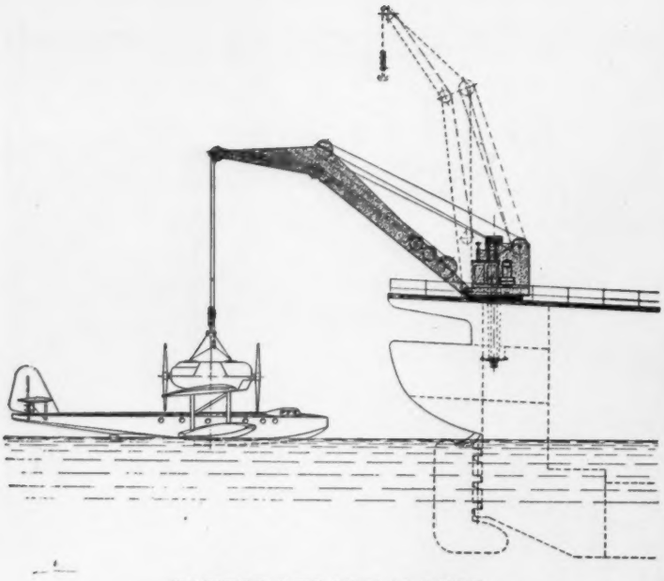
against a 20-mile wind—the wind helping to make the flight possible. Today we have transport planes that weigh a maximum of 24,000 pounds, can carry 21 passengers, and make speeds of more than 150 miles an hour in flying between our principal cities.

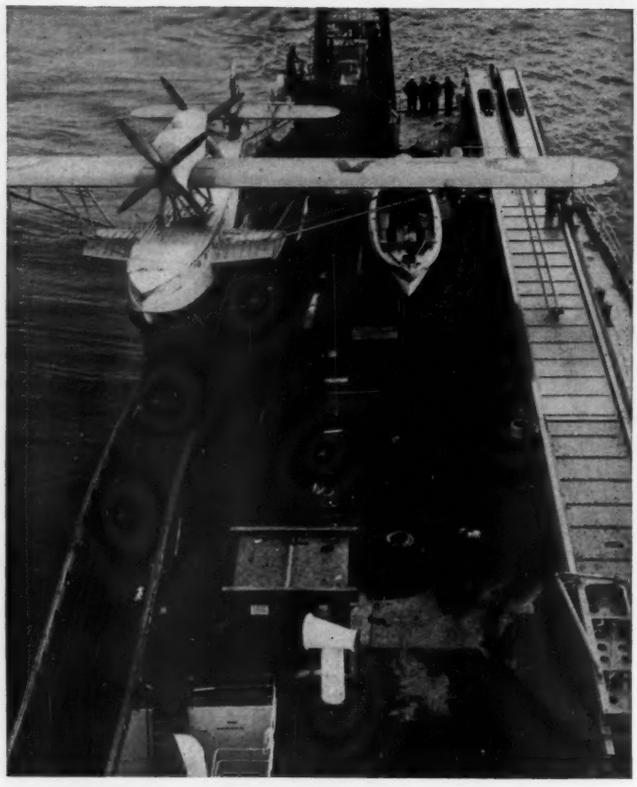
According to an official of the U. S. Bureau of Air Commerce, transport aircraft weighing 83,000 pounds are now under construction in this country, and one of America's leading aeronautical companies has been engaged lately in designing one that will weigh 186,000 pounds—93 tons. Before the end of 1938 we shall probably have in service transport planes capable of making in excess of 200 miles an hour when driven by four motors and of accommodating 40 passengers. Our transpacific flying boats have a dead weight of 50,000 pounds, and for more than a year have been making regular passenger and cargo runs. Not so long ago the Pan American Airways System asked for bids from eight American aircraft builders on three or more machines each to carry 100 passengers a maximum distance of 5,000 miles at speeds ranging—

WE HAVE nearly 2,300 airports and air fields in this country. Even so, all but a very few of them would be overtaxed if called upon to accommodate the latest and largest of our planes.

An official of the U. S. Bureau of Air Commerce has recently summed up the situation in these words: "The cold fact staring us in the face is the realization that within the next twelve months there will be mammoth transport planes in the air which, in all probability, cannot satisfactorily use more than five or six, at the most, of the airports in this country in their present condition."

The main problem arises from the increasingly long runways needed to launch these big craft into flight. The accompanying article suggests a possible means of overcoming the difficulty.





TAKING A PLANE ABOARD

The drawing illustrates the crane on the "Ostmark" lifting a plane aboard for servicing. The vessel is equipped with a wide canvas strip that can be unrolled and towed astern to serve as a ramp on to which a plane can be taxied in case the ocean is too rough to permit it to approach close enough to be picked up. The photograph shows a plane hoisted aboard the "Schwabenland" and placed on the turntable. The air-operated catapult which will launch it is shown at the right.

depending upon altitude—from 200 to 300 miles an hour; to have a pay-load capacity of 25,000 pounds for the complete distance; and to be equipped for a crew of sixteen. These figures indicate in general terms how amazingly we have progressed in mechanical flight in the course of the last 34 years.

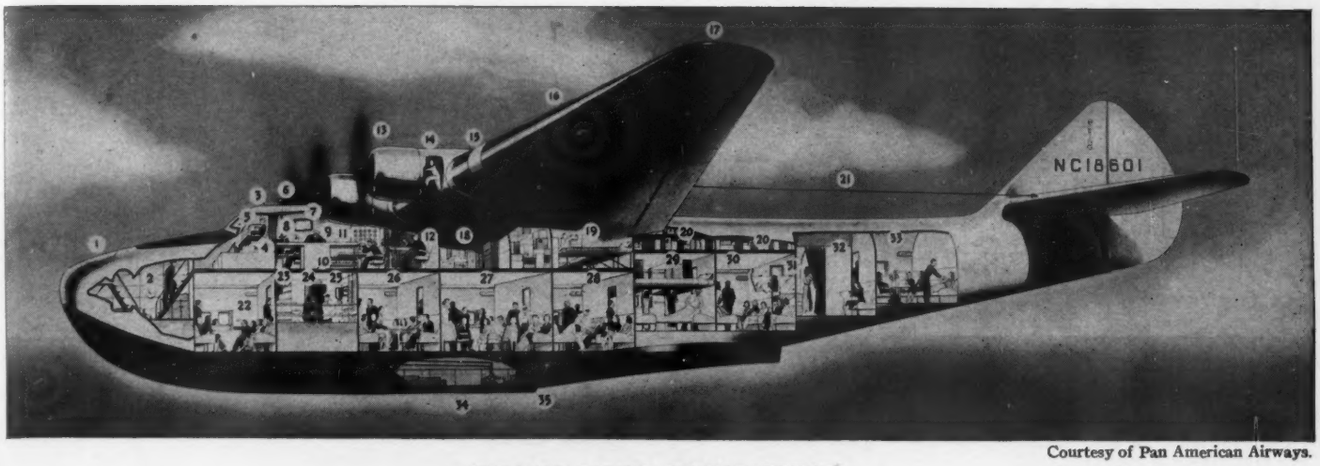
In the same period the aeronautical engineer has designed engines that have mounted steadily in power while being reduced in weight per unit of power, step by step. Today, instead of the crude 12-hp. engine devised by the Wright brothers, airplane engines are available that can develop 1,500 hp. each, while the newer cross-country transport planes and the bigger of the latest flying boats will be equipped with four motors, each ranging from 1,000 to 1,500 hp. For some time to come, the great seaplanes will probably be depended upon for transoceanic, long-distance flights; but there are recognized authorities that predict that transport planes, because of their speeds and fuel capacities, will ultimately be employed to make nonstop flights between Europe and America. Already, a British monoplane has been built which, during mild weather months, is expected to cross the Atlantic at a speed of 200 miles an hour with 22 passengers by day or twelve in sleeper service at night.

Whether the aircraft be of the transport or the seaplane type, the bothering problem in either case will be how to get it into the air at the take-off, especially when carrying a full pay load. Profitable operation of course demands that each shall have aboard a full passenger list and the maximum cargo. Commonly, both depend upon their own power and take-off speed to get them up and away. The land craft does this by an accelerating run on a prepared straight course of sufficient length, while the seaplane speeds along on the water until its velocity and the reactions of the air enable it to begin its flight. Fairly smooth water is essential to success, and waves and a strong wind may prevent its take-off, especially if full laden.

Just how pressing this problem is becoming was brought out recently by Col. J. Monroe Johnson, Assistant Secretary of Commerce, when dealing with some of the vital matters relating to our airports. After referring to the giant 40-passenger transport planes now building for service in the United States, he remarked: "We know that they will be heavier—that their inertia will be greater—that it is, therefore, unlikely that they can be accelerated to take-off speed so rapidly as the present craft—and that consequently they will probably need considerably longer runways for their take-offs and landings..... We know that some of the planes which served us well in earlier days could take off with a full load in less than 400 feet because the early engines were designed so that the full power output was operative at sea level ..... But today an entirely different picture is presented..... Gradually, then, we have been witnessing longer and longer take-off runs. And still longer ones appear to be looming just ahead of us. Even now, the 1,000-foot limitation on such runs, which was fixed by the Department of Commerce in 1929, is being pushed very close by many of the planes in use today. The need of an upward revision of that figure to facilitate operations of the planes of today and tomorrow has become so plainly apparent that a new regulation recently went into effect allowing some airline carriers a longer run in cases where the airport terrain and the airplane's performance are considered suitable."

Some important airports now have runways 3,500 feet long; but even 5,000-foot ones are advocated. Such runways may entail the acquisition of more property, and it is conceivable that that might be costly and even objectionable at certain places because of the upbuilt status of the neighborhood. It is not generally known that the Federal Government, municipalities, and commercial companies have conjointly spent fully $342,000,000 on our airport system; and to accommodate the machines just built, as well as those under construction and planned, it will be necessary either greatly to amplify a few of the principal airports or to establish commensurate facilities elsewhere. In short, the recent rapid trend towards much larger planes is reacting upon our airports just as kindred developments in the automotive field and the increasing number of vehicles have necessitated the construction of better highways and more of them.

A novel solution of the problem of getting transoceanic flying boats into the air is offered by the Short-Mayo pickaback seaplane—a large and rugged 4-engined flying boat equipped to carry on its back another flying boat designed for long-distance operation. The mother or nether craft must have sufficient power and seaworthiness to effect a take-off from rather rough water, and has to climb to a suitable altitude before releasing the flying boat—



Courtesy of Pan American Airways.

THE AIR LINER OF TOMORROW

Cutaway view of one of the six 42.5-ton flying boats being completed for Pan American Airways for transoceanic service. Each plane will be driven by four 1,500-hp. engines at a top speed of 200 miles per hour and have a cruising range of 3,200 miles. Fifty persons will be accommodated on long flights and 75 on shorter ones. 1- Anchor hatch; 2- Seaman's compartment; 3- Bridge where the flying controls of the liner are located; 4- First pilot; 5- Second pilot; 6- Radio-direction-finder "loop"; 7- Navigation compartment; 8- Radio officer's post; 9- Chart room—navigator's post; 10- Map case, marine library, drift sight bombs, flares, and navigational instruments; 11- Engineering officer, and mechanical engine and aircraft controls; 12- Captain's office; 13- Wright "Cyclone" 1500-hp. engines equipped with Hamilton constant-speed, automatic-adjusting propellers; 14- Mechanic's wing station; 15- Controllable landing lights; 16- Wing spread, 152 feet; 17- Navigation lights; 18- Main cargo hold which extends into wing; 19- Crew's sleeping quarters; 20- Luggage holds; 21- Over-all length of ship, 109 feet (height 28.5 feet); 22- First passenger compartment with accommodations for ten persons; 23- Spiral staircase to bridge; 24- Men's retiring room; 25- Galley in which two stewards can work simultaneously and where food can be prepared for 85 persons; 26- Second passenger compartment for ten persons; 27- Dining lounge with accommodations for fifteen passengers; 28- Third passenger compartment for ten persons; 29- Fourth passenger compartment for ten persons, illustrating method of making up berths for conversion of air liner into ocean sleeper; 30- Fifth passenger compartment for ten persons; 31- Ladies' dressing room; 32- Sixth passenger compartment; 33- Private cabin suite; 34- Fuel pumps for transferring fuel from sea-wings to wing tanks; 35- Auxiliary hold.

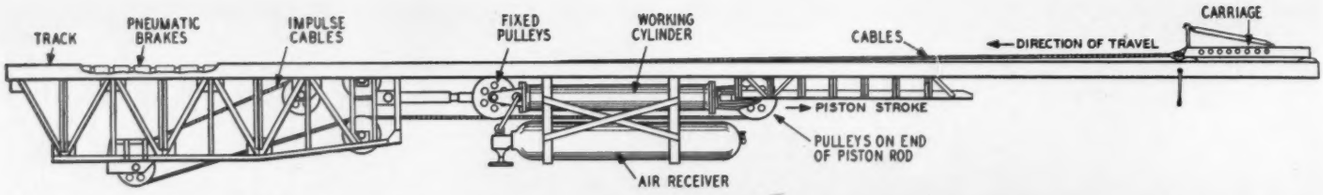
conditions being favorable—for continued flight under its own power. The mother plane then returns to the base port. In this way the long-distance seaplane would not be hampered by rough water in making its take-off and would be launched into the air with its maximum pay load and fuel tanks filled for the nonstop run. The fundamental shortcomings of this composite arrangement are that both planes must be in perfect operating condition to make it practicable and safe to launch the upper one, and that success hinges upon complete coöperation between the personnels of the two craft. Furthermore, the prevailing wind, while perhaps not too boisterous for flight, may be strong enough to kick up seas that might prevent the mother plane from getting off the water, if they did not actually make its use hazardous.

In January of this year Prof. J. C. Hunsaker, of the Massachusetts Institute of Technology, had this to say about how the latest and largest land-transport planes could be helped into the air when full laden; and, in principle, what he described was tested with considerable success several years ago at the Royal Aircraft Establishment, Farnborough, England. It was then found possible to launch a 9-ton plane into the air after a 3-second run of only 100 feet instead of the then accepted run of 900 feet. Professor Hunsaker thus detailed his scheme: "It seems simple to imagine a field with no equipment except a powerful subsurface winch at the center. There would be radial runways, 1,500 feet long, one of which, corresponding to the wind direction, could be selected for the take-off. The airplane, equipped with a stable 3-wheeled landing gear, would be towed by a cable from the winch, exactly as a glider is brought up to flying speed. The pilot would operate his engines in the normal manner, and the take-off would be normal in every way, except that the winch would give the assistance necessary to accelerate. The towing cable would automatically unhook as the airplane passes over the winch house."

People familiar with what the U. S. Navy has done to adapt the airplane to marine use will probably recall how our aeronautical experts of that service, as far back as 1912, wrestled with the problem of "shooting" a plane from the deck of a ship after an initial run of not more than 50 feet. Capt. Washington I. Chambers, U.S.N., then devised a crude air-driven catapult which, after months of experimenting, finally reached a stage where it was possible to project a seaplane with its pilot aboard into the air. The trial catapult was mounted upon a float, and the launchings took place when only a gentle breeze was blowing. Later, based on those pioneer efforts, men of the Navy developed mechanically efficient catapults that could shoot large seaplanes from the decks of vessels of the fighting fleet. They could be moved in an arc so that the aircraft could be launched against the prevailing wind to make the maneuver safe and effective. The naval catapult has successively undergone improvement during the intervening years.

Some of the speedy French and German transatlantic liners have been equipped with pneumatic catapults for launching seaplanes when several hundred miles offshore either to carry mail back to the ports of departure or to deliver it at the ports of destination hours in advance of the arrival of the boats. Another commercial and peacetime application has been in connection with the transatlantic seaplane service maintained by the Lufthansa-Condor Syndikat between Berlin and South America. Catapults have been placed aboard two erstwhile German merchant steamers that were adapted to function as mobile bases to service the Syndikat's planes in midocean or elsewhere along the route whenever occasion required. The vessels in question—the *Westfalen* and *Schwabenland*—have alternated in taking care of the twice-weekly, 1,660-mile, transatlantic mail-carrying trips of the German seaplanes between Bathurst, British Gambia, on the west coast of Africa, and the Island of Fernando de Noronha, off the coast of Brazil.

When the *Nordmeer* of the Deutsche Lufthansa A.G. made a trial flight across the Atlantic last August, that plane was serviced in the long run of 2,392 miles between the Azores and our shores by two catapult-equipped steamers, the *Schwabenland* and the *Friesenland*. On leaving Horta for the westward journey, the *Nordmeer* was catapulted from the *Schwabenland*. Later the flying boat was launched from the deck of the *Friesenland*, which had crossed the Atlantic and taken a position in Long Island Sound for that purpose. The

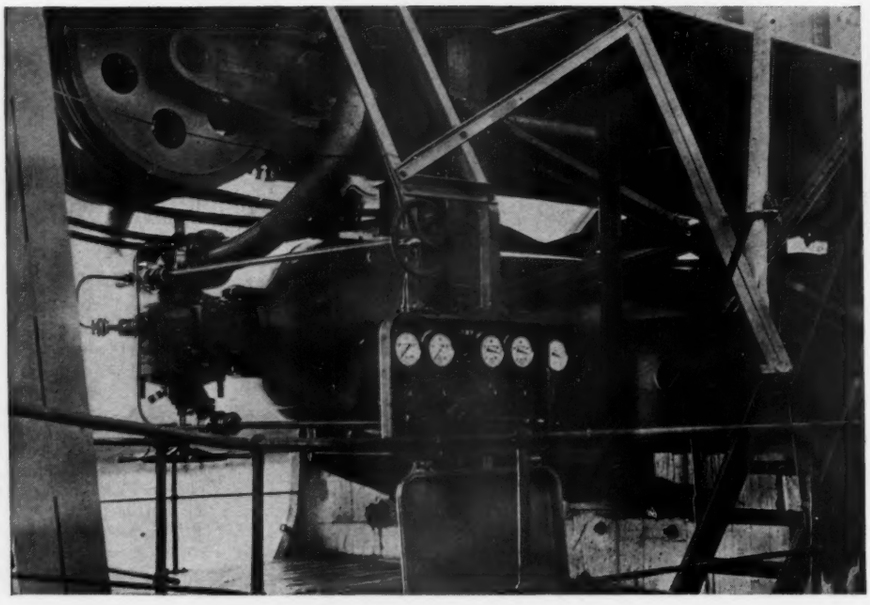


base ship not only lifted the big seaplane but also refueled it for its flight home.

Profiting by their experience with old, adapted steamers, the Germans designed and built a ship especially for use in the tropical waters between Africa and South America to service the seaplanes flying between Berlin and Brazil. The *Ostmark*, as she is named, has an over-all length of 245 feet, a beam of 37 feet, twin screws, and two oil engines, each of 900 bhp., which can drive her 14 miles an hour. The engines contribute to operating economy because no fuel is consumed when the craft is not underway. They are direct-coupled to the propeller shafts; and while this would ordinarily not be good practice, the arrangement is satisfactory because the *Ostmark* is moving under power only during relatively short periods. She idles along the seaplane route, standing ready to serve an aircraft whenever needed.

A second seaplane-service vessel, the *Ostland*, has recently been completed. This craft is for the North Atlantic run and is much like the *Ostmark*. She is also driven with heavy-oil engines and can maintain her position as a base ship even when the North Atlantic is in a stormy mood. She is fitted with one of the latest types of large catapults capable of launching a loaded seaplane weighing approximately 16.5 tons. On opposite sides of each of these vessels, amidships, are two swiveled smokestacks and two adjoining masts held erect by interconnecting stays. When these ties are released, the masts and stacks swing outward and down so as to afford a clear path for the catapulting of a seaplane—the latter advancing toward the bow during the launching operation. Each service craft mounts at her stern an electrically operated crane with a maximum reach of about 53 feet and a lift of 15 tons. Its function is to raise a plane from the water and to place it in the position in which it has to be run on to the catapult track preparatory to projecting it into the air.

A number of difficulties had to be overcome before it was practicable to pick up a seaplane and to put in on board the base ship. When the surface of the water is smooth, the aircraft can alight upon the sea and taxi within reach of the crane designed to raise it from the water. When the condition of the sea is too disturbed to permit this simple operation, then the mother craft tows astern of her a wide and strong canvas strip stiffened transversely on the underside. This is usually rolled up on a reel close to the vessel's square stern. The sail is unrolled and dropped overboard as the ship travels slowly ahead, and may reach out behind for a hundred feet or so.



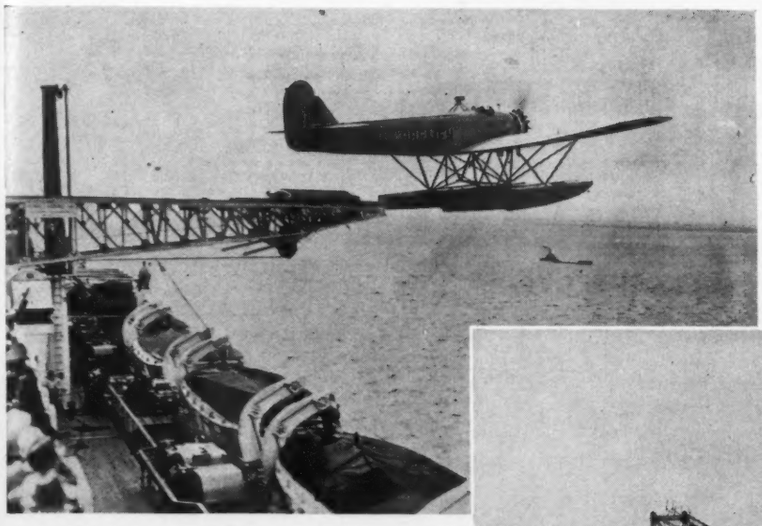
THE HEINKEL AIRPLANE CATAPULT

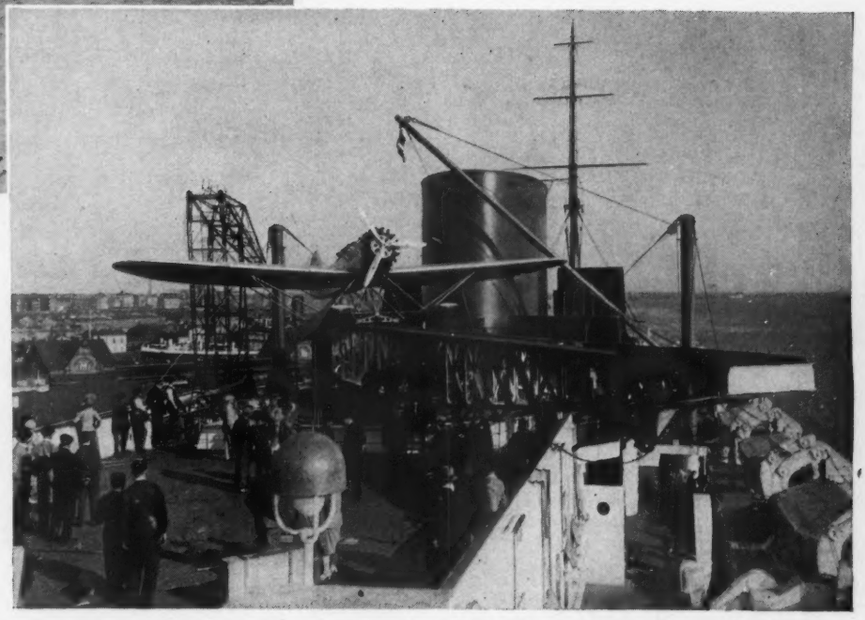
With this apparatus, a plane weighing 15 tons or more can be brought up to a speed of 93 miles an hour during a run of 103.5 feet that lasts only 4½ seconds. Compressed air, held at 2,275 pounds pressure in the receiver, is admitted to the working cylinder and drives its piston forward. By means of multiplying pulleys and ropes, the speed at which the airplane carriage is drawn is increased until it is sixfold that of the piston speed. Just before the piston reaches the end of its stroke, air is by-passed to the forward end of the cylinder, thereby cushioning the stroke and stopping the piston without shock. The aircraft is automatically released from the carriage when it has attained climbing speed, and the carriage is brought to a stop by the deceleration of the piston and by pneumatic brake blocks near the end of the runway. The photograph shows the control station beneath the catapult runway on the motorship "Ostmark." The lower cylinder is the air receiver, and above it is the operating cylinder with the large multiplying pulleys.

The lower side of this strip is fitted with pockets that face toward the craft. As the vessel advances, these pockets open and act like sea anchors, gripping the water and stretching the canvas taut so that it will serve as a ramp upon which the seaplane can settle. It does this by taxiing into position just before the ship increases her speed, which causes the canvas to rise up and to strand the flying boat upon it. As the canvas is wound in on the reel, the plane is dragged near enough to the motorship to be picked up by the crane. To offset the rise and fall of the seaplane on waves during the hoisting operation, which would cause alternate and sudden stresses on the lifting tackle, the cranes on the *Ostmark* and the *Ostland* are equipped with automatic controls that compensate for wave action and lifting speed. This was a problem that was only partly solved in the case of the earlier vessels adapted for base service.

When a plane is picked up it points in the same direction as the ship; but to get it aboard it is swung through a half circle, its bow then heading toward the stern of the mother craft. Therefore the plane is lowered on to the catapult car, which at that stage rests upon a turntable that permits swinging the plane around and pointing it toward the bow of the vessel ready to be moved forward on to the catapult track. This track extends for an over-all distance of 136 feet. The carriage on which the seaplane rests is 14 feet 5 inches long; and during its accelerating run it is drawn toward the bow of the ship for 103.5 feet. After the plane has lifted clear, the carriage is checked by pneumatic brakes and brought to a standstill within a distance of 18 feet. The two rails of the catapult track are I-beams machined on the top flanges, and the carriage slides on four shoes which so embrace the flanges that the carriage cannot be lifted from the track when the wings of the seaplane are exposed to gusts of wind.

The essential mechanical operating features of the catapult are a compressed-air-driven piston which has a stroke of approximately 17.5 feet, a piston rod connecting with multiplying pulleys and ropes, and the launching carriage to which one





PASSENGER-SHIP CATAPULTS

Several of the speedy French and German liners are equipped with catapults for launching small planes that carry mail back to ports of departure or speed it to ports of destination in advance of the arrival of the ships. These pictures were taken on the "Bremen" and the "Europa."

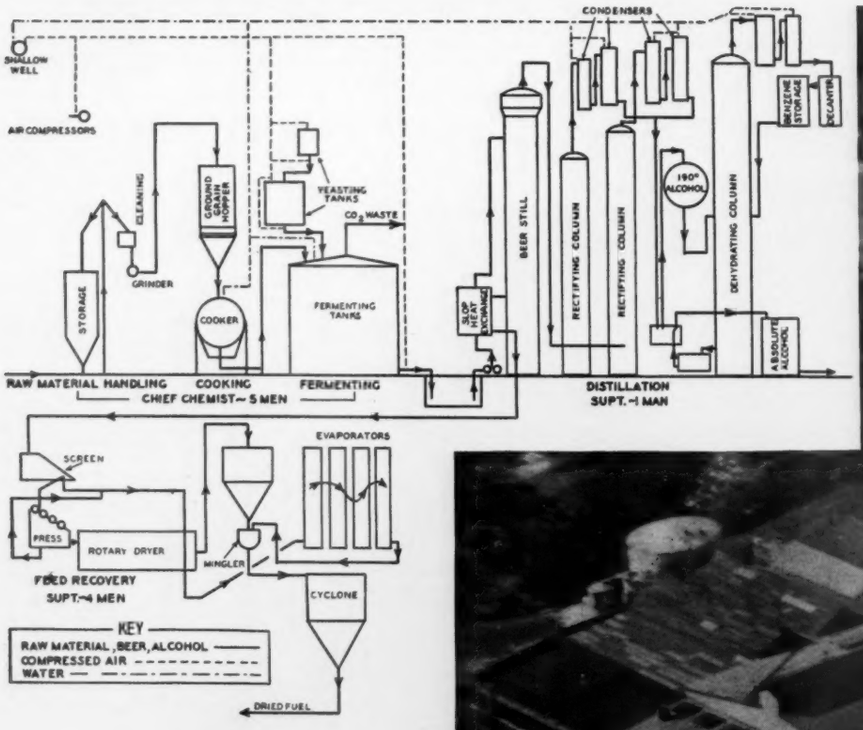
end of the towing tackle is secured. The arrangement of the blocks and ropes makes it possible for the movement and speed of the piston to be increased in the ratio of 1 to 6 in pulling the carriage forward. The air that actuates the piston is stored at a pressure of 2,275 pounds per square inch in a receiver placed beneath the catapult runway, and is delivered to the driving cylinder which is directly above the receiver. The cables of the catapult are tautened just before launching to obviate any jerking motion. This is done by admitting air to the cylinder at a pressure ranging from 114 to 142 pounds per square inch.

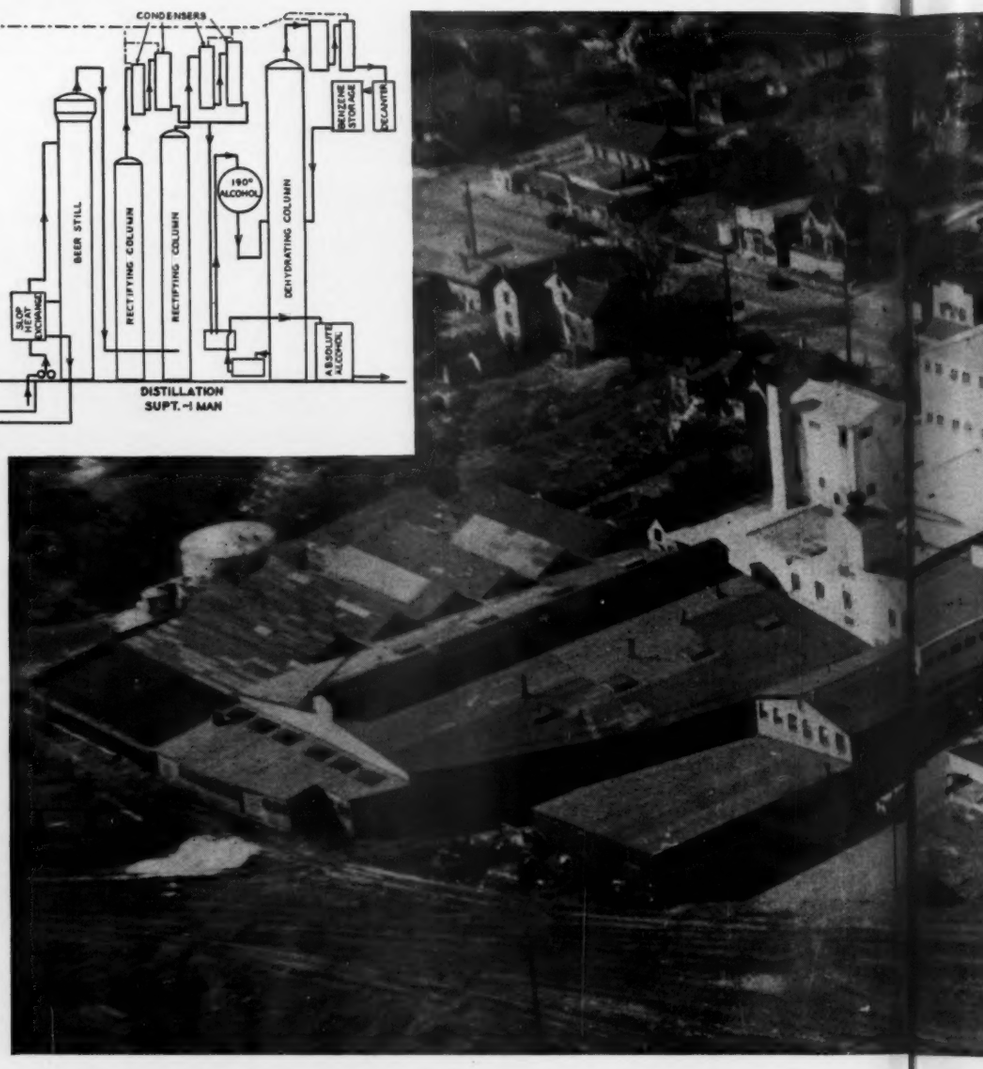
When pressure is applied for catapulting, the admission of the air to the cylinder is governed so nicely that acceleration reaches the desired maximum after about two seconds—the entire run of the carriage being effected in approximately 4½ seconds. Just before the end of the stroke, cushioning air is by-passed to the advance side of the piston and the stroke thus gradually reduced to zero without shock. The maximum force developed by the piston is 518 tons. The acceleration imparted to the seaplane is 3½ times that of gravity, and the maximum velocity reached is 93 miles an hour. The catapult on the *Ostmark* can launch a seaplane weighing as much as 16.5 tons and at the same time move the launching carriage, which weighs nearly 2 short tons. The total weight of the catapult, its associate apparatus, and the compressor plant is close to 105 tons.

The aircraft is securely held in position on the catapult carriage until climbing speed has been imparted to it. Then it is released by tripping gear, actuated by a ramp placed near the end of the runway. There are various interlocking controls that prevent any interference with sequential operations; and most of these are brought into play pneumatically. The catapult can be tested to make sure that it is fit for action without actually launching a plane; and communication can be maintained between the catapult operator and the seaplane pilot up to the instant of starting. The importance of this will be readily grasped.

The catapults aboard the *Ostmark* and the *Ostland*, as well as those carried by the German transatlantic liners *Bremen* and *Europa*, were constructed by the Ernst Heinkel Flugzeugwerke, at Rostock, Germany. That concern has been engaged in designing and building catapults for more than a decade. Doctor Heinkel, after much experimenting, decided that compressed air is superior to both explosives and electricity as a motive medium for catapults. He found that compressed air offered greater construction possibilities, and he also proved to his satisfaction that it permits of much nicer control of the starting operations. Step by step, at the plant in question, a succession of catapults of improved pattern and power have been built to meet the requirements of aircraft of increasing sizes and dead weights. While most of these units have been intended for use afloat, it should be manifest that it is feasible to mount them on land and thus to make them serve for launching not only seaplanes but also land-transport planes.

In the face of the situation developing at our airports where longer and longer runways will be needed to enable the bigger planes to effect their take-offs by initial accelerating runs, it would seem that the catapult offers a better and a more economical way of overcoming the difficulty. The engineer will certainly discover means whereby a catapult at any airport can be made to launch various planes having a wide range of weight and take-off requirements. Our own people have produced catapults of finished characteristics for naval service; and the same operating principles can be utilized in designing units for commercial aircraft. We are moving forward rapidly, very rapidly, in the field of aviation, and we should not hesitate to employ any agency that will contribute to the ease, safety, and economical handling of any and all sizes of airplanes that may be built, building, and projected. Ground space adjacent to airports in the vicinity of large cities is becoming increasingly valuable; and, for the sake of convenience and time-saving, airports should not be too far from the populous centers they are designed to serve. The catapult seems to offer a worth-while solution of a problem that will become more, rather than less, pressing with time.





FLOW SHEET

This diagram shows the various steps in the process of making industrial alcohol and its by-product, stock feed, from either grains or tubers. With minor changes in the first series of operations, the distillery can successfully convert any fruit or vegetable growth that contains either starch or sugar. The labor requirements for each shift in the three departments are given. At present, alcohol can be produced from corn for around 23 cents a gallon. This cost will be considerably reduced when compressors are added to manufacture dry ice from the large volume of carbon-dioxide gas that comes from the fermenters.

THERE is a brand new word in our English language—so new that you will not find it in the latest edition of Webster. The word is "chemurgy," sometimes referred to as "farm chemurgic." According to scores of renowned scientists and industrialists, the world will hear much on the subject during the next few years. Just as metallurgy, a branch of chemistry, means the bringing forth of metals and metalliferous materials from naturally occurring ores, the name "chemurgy" is now given to that branch of chemistry concerned with the bringing forth of chemical compounds from plant life for industrial application.

The United States has an aggregate agricultural plant valued at $55,000,000,000, and there was a time when it produced four-fifths of everything we used. Today, however, principally owing to the wholesale displacement of horses and mules by motorized equipment, only about one-third of the total weight of the materials directed to man's service is raised on our farms. There has been a gradual shrinkage in both domestic and export markets, and today this is equivalent to the productive capacity of 100,000,000 acres. A sorry outlook for the farmer!

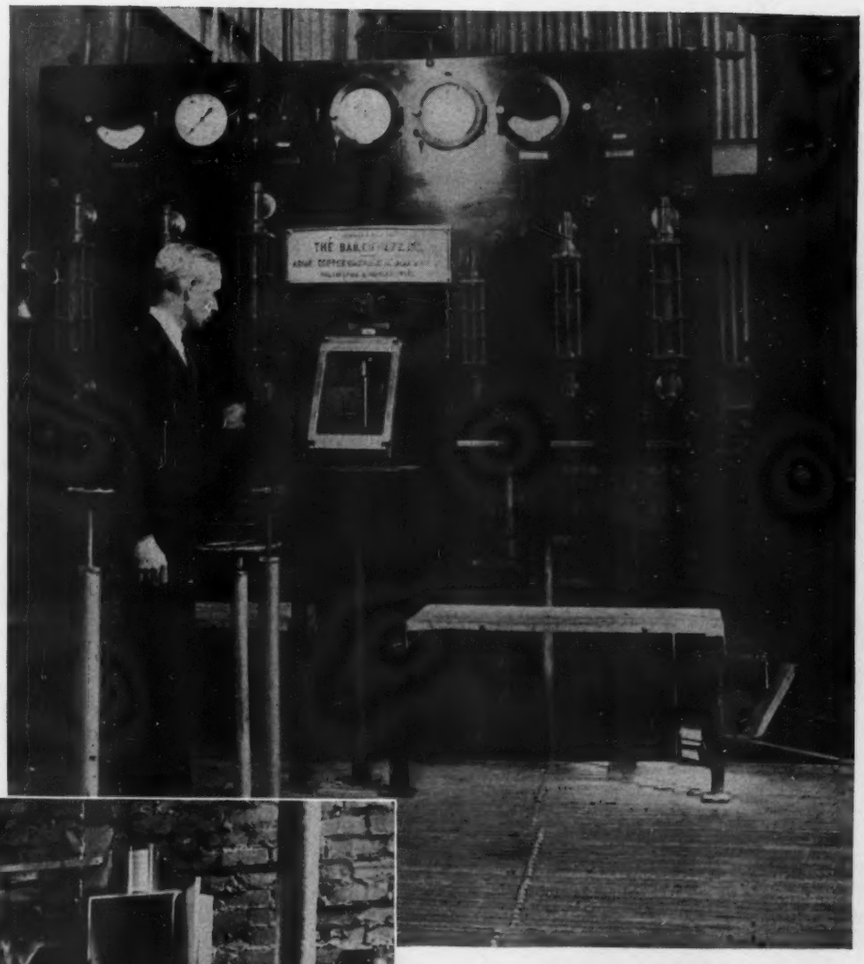
Three years ago, representatives of agriculture, science, and industry met at the First Dearborn (Michigan) Conference to discuss ways and means by which all three groups might coöperate in establishing new industries that would rely principally on farm crops for raw materials. Simply stated, they were hunting new domestic markets for farm produce. Why was industry concerned with farm markets? Wasn't industry having enough trouble finding markets for its own products? Henry Ford, one of the staunchest supporters of the farm chemurgic movement, thus summed it up, "Business is only an exchange of goods. If we industrialists want the American farmer to be our customer, we must find ways to become his customer."

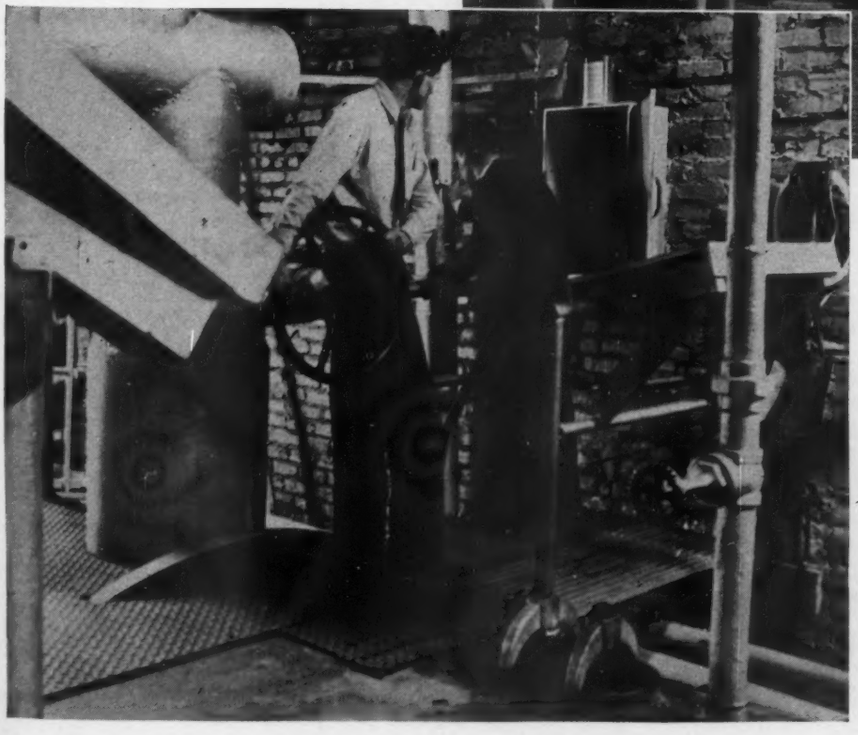
Since that historic meeting in Dearborn in 1935 much has been accomplished through the joint efforts of science, industry, and agriculture. For instance, the Champagne Paper Corporation has announced that it will build at least one large mill to manufacture tissue paper from flax and hemp fibers: imported linen rags are regularly used to make this particular kind of paper. Sixteen new pulp, kraft, and newsprint mills now in operation in the South all depend on southern pine for raw material. The booming plastic industry is finding a variety of new applications for corn proteins. Cottonseed oil is edging into new industries. In the paint industry the chemurgic movement is at present centered around three oils—tung, soy bean, and perilla—the first two of which are now definitely established commercial crops in this country.

One of the most interesting of all the current experiments in chemurgy is the production of industrial alcohol from farm crops of all kinds. At Atchison, Kans., is an alcohol plant especially equipped for processing farm products. It is operated by the Atchison Agrol Company and is sponsored by The Chemical Foundation, Inc., of New York City, whose officers predict that there will some day be 500 or more similar distilleries scattered throughout the agricultural sections of America. In sponsoring the distillery, The Chemical Foundation, a quasi-public institution, is attempting only to demonstrate the practicability of converting surplus crops into

Alcohol from the Farm

Wilbur Fiske





THE DISTILLERY

Across the top center of the two pages is the Atchison Agrol Company's establishment, at Atchison, Kans., as seen from the air. The light-colored buildings, which are painted aluminum, constitute the distillery, where 10,000 gallons of anhydrous alcohol are produced daily. The other buildings are devoted to the manufacture of farm implements.

CONTROL STATIONS

After the mash has been cooked for an hour, barley malt is added to convert the starch content into sugar. This mixture is held at a temperature of 145°F. for one hour and then cooled by vacuum distillation to 86°, at which time the yeast is added. At the left is the control station for the barometric condenser which effects the cooling. The still-house operations are all controlled by one man by means of the instrument panel pictured above.

YEAST-CULTURE TANKS

It is essential that the yeast culture be of maximum vigor when used to inoculate the fermented grain mash so as to convert its sugars into alcohol and carbon-dioxide gas. The preparation of the culture is carefully controlled at every step. The picture shows the first yeast-culture tank being inoculated from a culture flask. Twenty-four hours later the yeast will have grown sufficiently to inoculate 1,000 gallons of mash and in another 24 hours there will be enough of it to inoculate one of the 20,000-gallon fermenters. To guard against contamination, the carefully selected cultures are transferred by sterilized compressed air.

alcohol and its by-products. The Foundation itself does not plan to erect other distilleries: the Atchison plant is to serve only as a proving ground and model that other communities or firms can study and duplicate.

Farm marketing experts are enthusiastic about the alcohol plant because of the diverse raw materials which it can use. Successful test runs already have been made with many grains—corn, barley, rye, wheat, and grain sorghums—and with tubers, including sweet potatoes, Irish potatoes, and Jerusalem artichokes. "Since the alcohol we manufacture is not for human consumption, we can use the substandard or even half-spoiled crops, paying the farmer full price if the starch content is satisfactory," states Dr. Leo M. Christensen, general manager of the plant. "Last year we used a carload of corn that was unmarketable because it had been frozen before maturity. We have also used much grain that has been damaged in elevator fires. Musty or mildewed grain is entirely satisfactory for our purpose.

"It is our understanding that in California tons of evaporated fruit are often spoiled in drying. One or more plants such as ours, strategically located, could salvage spoiled fruits which are now dumped, as well as the surplus fruits that glut the market during seasonal peaks. Similarly, alcohol plants could be established in Maine for both surplus and cull potatoes. In fact every fruit, grain or vegetable growing area in the nation could support a distillery."

No diminutive laboratory is the distillery at Atchison. The plant proper occupies 23,000 square feet; and railroad sidings, roadways, and a yard represent an area again as large. The value of the property is approximately $330,000. Every 24 hours it produces 10,000 gallons of anhydrous alcohol, enough to fill a large railroad tank car. As a by-product, the distillery makes a high-protein stock feed from the spent mash—the quantity of feed varying with the raw material used. A bushel of corn weighing 56 pounds will yield 16 pounds of alcohol and 16 pounds of feed residue. When running on corn, 34 tons of feed are sacked daily.

Here is what happens to a truckload of grain when unloaded at the alcohol plant. Suppose it consists of 4,000 pounds of corn —71 bushels. If brought in by a farmer, he is either paid cash or, more likely, he accepts part payment in stock feed which sells at about the same price as cottonseed meal. The corn is unloaded by a screw conveyor into one of several bins to await processing. Total grain storage capacity is 20,000 bushels.

Before the chief chemist can withdraw the two tons of corn from storage for conversion into alcohol, he must notify the Internal Revenue agent, on duty at the plant, under whose supervision the grain is weighed out. Seven days later, the superintendent of distillation must, for the satisfaction of the Government man, produce in its stead 173.95 gallons of anhydrous alcohol. Actually, the plant uses from 4,000 to 5,000 bushels of grain a day.

The first stage in processing is the grinding of the corn into meal. This is done with ordinary motor-driven milling grinders. A screw conveyor elevates the corn meal to a hopper located near the roof of the tall building. From this hopper, the meal can be measured out and dumped directly below into one of three cookers, each of which has a capacity of 7,360 gallons. Water is delivered to these tanks from one of four shallow wells, 30 to 40 feet deep, by means of air lifts. Air at 80 pounds pressure is available throughout the plant. It is supplied by one compressor of 750-cfm. capacity and by two smaller machines, each of 70-cfm. capacity. The wells are required to furnish about 200 gpm. of make-up water. However, total water requirements, including water for the condensers (recirculated after cooling), approximate 1,000 gpm.

Practically every private firm making industrial alcohol in the United States uses blackstrap molasses as raw material, but the production of alcohol from starchy substances such as corn, wheat, rye, and tubers is somewhat more complicated because the yeasts do not affect starch as such. The starch must first be converted into sugar, a process called saccharification or malting. This is usually accomplished by means of barley malt. After the mash—corn meal and water—has been cooked for one hour the barley malt is added, and then the mixture is held another hour at a temperature of 145°F. In its conversion, 100 pounds of starch takes on 11 pounds of water to form 111 pounds of sugar.

The mash is now cooled to 86°, and at that stage is ready for one of the most important operations—inoculation with yeast. Yeast acts upon sugar to produce alcohol and carbon-dioxide gas. It is highly essential that the yeast culture be free from contaminating microörganisms and that it have the highest vigor. As hundreds of species of unwanted yeasts are liable to be floating as dust in the air, distillers, as well as brewers and bakers, guard their yeast cultures—pure strains which they have developed and selected for their own particular use—with the utmost caution. Compressed air plays an important part in guarding cultures from contamination.

The cultures when started in the plant laboratory are nothing more than tiny specks, one speck in each of a dozen small, covered glass tubes reposing in rows on a shelf in an "incubator" in which a temperature of 85° is automatically maintained. As the yeast in each tube multiplies by budding, it is transferred to large flasks with the greatest of caution to prevent contamination, and again to larger flasks until, after four transfers, there is enough available to inoculate 80 gallons of carefully sterilized mash in a special type of culture tank. Within 24 hours, after the yeast has again multiplied, it is forced by means of sterilized compressed air into a 1,000-gallon tank of sterilized mash. Twenty-four hours later the culture, which was once the size of the head of a pin, is adequate for the inoculation of one of the 20,000-gallon fermenter tanks.

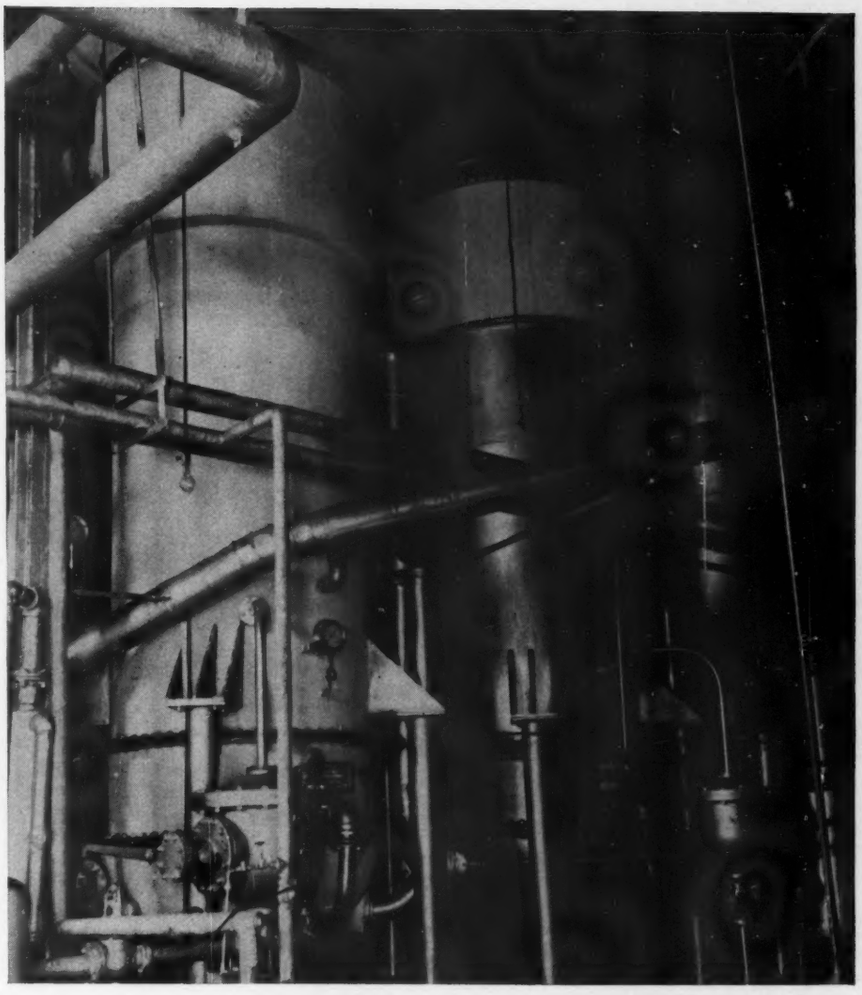
Compressed air, filtered through spun

glass and practically sterilized by the heat of compression, is preferred for the work of transferring yeast cultures. The alternative means would be pumps which, according to Doctor Christensen, are subject to contamination every time they are exposed to the atmosphere for cleaning, which is often required. So long as compressed air has been in service in the yeast laboratory, no trouble of this sort has been experienced. Sterile compressed air is also used to aerate the yeast both in culture tanks and in the fermenters. The yeast is of the aerobic variety, which needs a supply of fresh air during the first four to six hours of each 24-hour cycle.

There are eight 20,000-gallon and three 110,000-gallon fermenter tanks. Fermentation in these tanks takes three days. At the end of that period the alcohol content amounts to 7-8 per cent, and the liquid is then known as beer. From the tanks it is transferred to a settling basin, whence the residue is diverted to a feed-recovery unit. Here, again, compressed air serves instead of pumps in order to prevent the residue from settling at the tank outlets. The beer, itself, is delivered to the distillation department where it successively passes through one beer still, where it becomes 80 proof, and through two rectifying columns in which it becomes 190 proof alcohol. This is the proof or strength of most industrial alcohols on the market; but as the purpose of this plant is to make anhydrous or water-free alcohol, the liquid continues on its journey for further treatment in what is said to be the largest dehydrating column in the world. This enormous column reaches upward from the basement, passes through the succeeding floor, and emerges 69 feet above, crowding the roof. In it the 190-proof alcohol is mixed with benzene, which absorbs the remaining moisture and leaves absolute alcohol of almost 200 proof. Next comes the denaturing process in which certain chemicals are added to render the alcohol unsuitable for drinking. At this stage the foulest smelling chemicals imaginable come to the rescue of the Internal Revenue Department, thus discouraging bootleggers.

Slops that are separated from the beer before it is distilled are transferred to the feed-recovery department where they are first passed over a screen and then compressed. Both the watery portion of the slops, which goes through, and the bulky residue which is arrested by the screen are made into the same kind of stock feed, called distillers' grains, but by two different methods of evaporation.

The watery slops, which are too wet to be handled in the rotary drier, pass through a quadruple steam-heated evaporator which produces a perfectly dry residue: the heavier material is fed from the screen into the large rotary drier. This is heated by waste fuel gases from the steam power plant which uses natural gas for fuel, blowers pulling the hot gases from the smokestack and forcing them through the drier. The products of both the drier and the evaporator are mixed and sacked. This summer the management hopes to effect further economies by installing a compressor in order to make 20 tons of dry ice daily from the carbon dioxide now escaping into the atmosphere from the fermenter tanks.



FEED-RECOVERY UNIT

The residue contains proteins and other nutritious elements and is dried for use as stock feed. That portion of the dealcoholized mash that passes through a dewatering screen is dried in the quadruple-effect evaporator shown here. The heat used is obtained from steam.

The cost of manufacturing anhydrous alcohol from crops depends, of course, on the current prices of the various raw materials. At the Third Dearborn Conference, last September, W. W. Buffum, treasurer of The Chemical Foundation, said that the cost of producing alcohol from corn at 56 cents a bushel delivered at the plant of the Atchison Agrol Company, of which he is president, is 22¾ cents per gallon, but that it would probably be lowered as much as six cents when the dry-ice plant is in operation.

In discussing the prices which the plant intends to pay for raw materials Mr. Buffum made the following statement:

"As a simple method of computation, inasmuch as there are 56 pounds of corn in a bushel, let us consider corn on a basis of 56 cents a bushel, or one cent a pound. The cost of alcohol on this basis is 22¾ cents per gallon. Therefore, we can pay one cent per pound for corn, rye, wheat, and grain sorghum, or 60 cents per bushel for wheat, 48 cents per bushel for barley, and continue to manufacture alcohol at 22¾ cents per gallon. For Jerusalem artichokes we can pay $5.25 per ton; for sweet potatoes, $7.05 per ton; and for Louisiana molasses we can pay one cent per pound for its sugar content. We consider these figures as the minimum prices which should be paid to the American farmer for the products he grows for use in the manufacture of industrial alcohol."

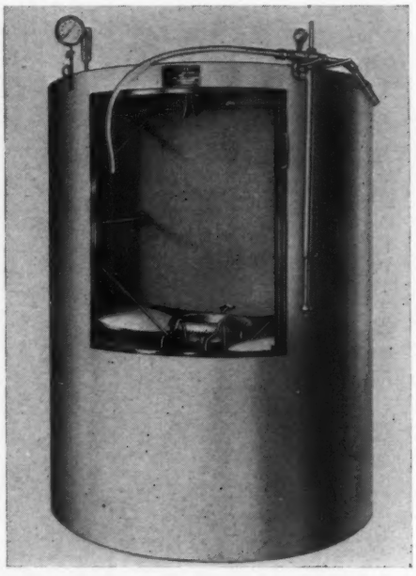
Today, in the vicinity of Atchison, it is not uncommon to meet a farmer who, without trying to be humorous or unlawful, will boast that his corn "went a hundred gallons to the acre." But with Government in control of production and of prices of certain farm crops, time alone will tell what the industrial alcohol distilleries in the nation-wide farm chemurgic program will eventually be worth.

Four Operations in One

A. M. Hoffmann

MILLIONS of returnable steel barrels and drums are being used today as shipping containers, and this means that millions of steel barrels and drums must be reconditioned before they can again start out with new consignments. In the oil and paint industries there is a large demand for both heavy- and light-gauge containers of this type, while chemicals, inks, and many other products of the liquid variety are now generally transported in the so-called one-time shipper or light-gauge drum. These packages represent a fairly heavy investment, and many plants in which large numbers of them are handled daily in the normal course of business have departments with equipment of their own devising where returned empties are examined and the good ones thoroughly cleaned inside and outside, and painted if necessary. There are also dealers who buy used barrels and drums and sell them after putting them in serviceable condition.

With few exceptions, the work of reconditioning has remained much the same since the returnable steel container came into general use. A common practice is to steam the package inside; place it over a spray nozzle and wash it out with a hot cleaning solution; rinse it with hot water introduced by a second spray nozzle; upend it and insert a suction pipe to withdraw any remaining water; and set it over hot-air pipes to dry the inner surfaces. Next the bung hole is closed and the outside given attention. First the barrel goes into a scrubbing machine to remove the paint, and when that is done and the bung has once more been taken out it is dried by passing it through an oven on a belt conveyor. It is a long-drawn-out procedure the order of which is sometimes reversed. It calls for various pieces of equipment that not only occupy considerable floor space but may, in a department through which hundreds of drums and barrels pass daily, require the services of numerous men. While improved methods have been introduced, especially for small-scale operations, the package in every case has to be handled several times before it is ready for the finishing touches.



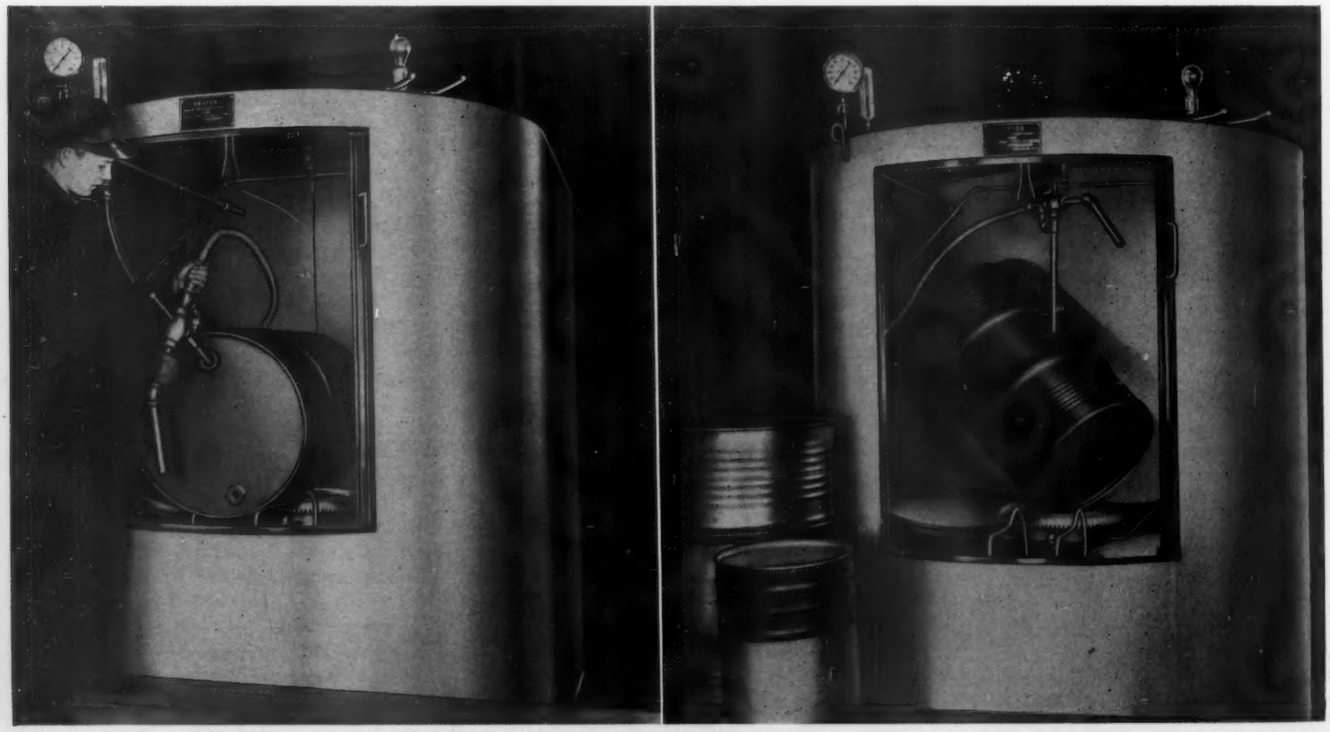
SINGLE-CELL UNIT

Whether of one- or multiple-cell type, the structural features and method of operation of all the machines are the same. Two 6-cell units have been recently built for one of the principal oil companies that reconditions many returnable barrels and drums daily. Below, left, the operator is in the act of inserting in a drum the combination spray and siphon by means of which the inside is washed, rinsed, and dried. At the right is shown a side-filler drum firmly held in position on the turntable by the spray-siphon.

Recently, The Portland Company, of Portland, Me., a concern that has manufactured high-grade machinery and fabricated steel equipment for nearly a hundred years, has announced the development of a self-contained unit that will do all the work in one operation. It has taken five years to bring the machine to a commercial stage; and, according to the maker, it will strip, wash, rinse, and dry a container inside and outside expeditiously and at low cost.

The Portco, as the reconditioner is designated, functions automatically, and comes in different sizes and in batteries of four, six, and eight cells for cleaning packages in quantity. They are designed to accommodate standard drums and quarter-, half-, and full-sized steel and wooden barrels, as well as tubs, pails, cans, and grease containers no matter whether they are side-filler packages with 1½- or 2-inch-diameter bung holes or end-filler packages. In the latter case they can be entirely open at one end; but the bung holes should not be less than 1½ inches in diameter.

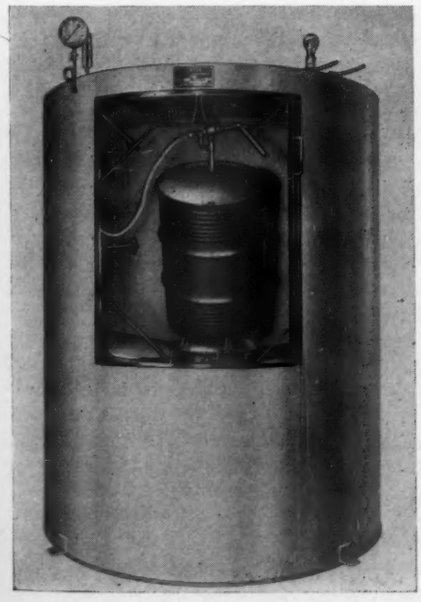
The accompanying pictures show the



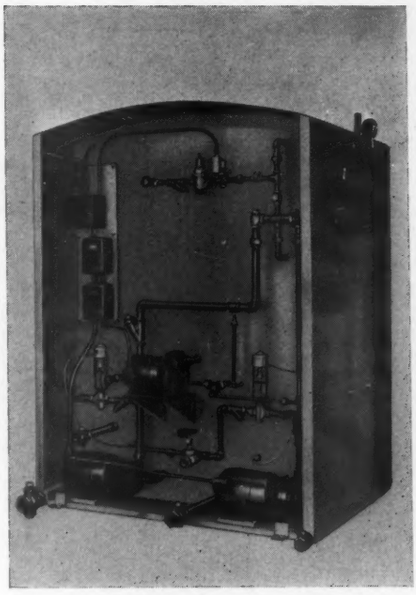
single-cell Portco 60, which is suitable for plants with a moderate volume of business. Except in the matter of size, it does not differ in construction or in method of operation from the other units. The returned drums that are good for further service are placed, one at a time, on a short runway inside the machine and immediately back of the sliding door. While in that position, a combination spray pipe and siphon with a flexible tube is inserted in the bung hole, and then the package is pushed on to a small turntable where it is firmly held by the spray-siphon pipe. The operator now closes the door, and this action automatically starts the working cycle and flashes a signal light on the outside of the reconditioner that continues to glow until the cycle is completed. Slowly the turntable begins to rotate, and a standard automatic timing device, which controls all the subsequent operations, begins to function.

First a pump is set going. This, together with all the other necessary apparatus except an air compressor, is housed in a compartment in back of the Portco. Through a series of spray pipes built in the cleaning chamber, a hot washing solution is thus introduced under sufficient pressure to strip the paint from the outside of the drum. At the same time the pump feeds the solution into the package through the spray and suction tube, thus cleaning it inside and outside simultaneously. The tank containing the washing solution is an integral part of the machine. It is in the bottom, and is provided with steam coils, automatic heat control, an overflow, a scumming arrangement, and a valve for dumping.

The combination spray and siphon is of double-tube construction with a by-pass, and delivers the incoming solution into the drum by way of perforations in the outer tube—the inside one serving as the siphon. By this arrangement it is possible to use the same water for washing and for siphoning and to withdraw the cleaning solution as fast as it is pumped into the drum. The exhaust goes to a drain or transfer pan, and from there back into the tank for recirculation. Only a very small quantity of water remains in the package at any time during this operation.



AN END-FILLER DRUM IN PLACE



THE MECHANICAL EQUIPMENT

The wash and rinse pumps that do most of the work are in the bottom of the compartment and are of the Ingersoll-Rand Motorpump type.

When the washing cycle is completed, the pump is shut down by the automatic timer, which next actuates an air solenoid. This causes compressed air to flow through the spray-siphon—the suction thus induced removing any cleaning solution left inside the drum. This also flows back into the tank. The air for this purpose is taken direct from the compressor. Rinsing with hot water follows. Again the timing device gets busy and, after closing the solenoid, starts the pump provided for this work.

Inside and outside, the package is rinsed in the same manner in which it has been washed, the same piping serving to deliver and to withdraw the clear water used. The latter is stored in a separate tank and is returned to it by means of the drain pan previously mentioned which is controlled either by the wash-water or the rinse-water pump, as the case may be. This tank also is in the lower part of the Portco, is heated by live steam, and is arranged so that each barrel or drum can be rinsed with fresh water, if desired. Automatic heat control, an overflow, and a valve for dumping are features of the tank.

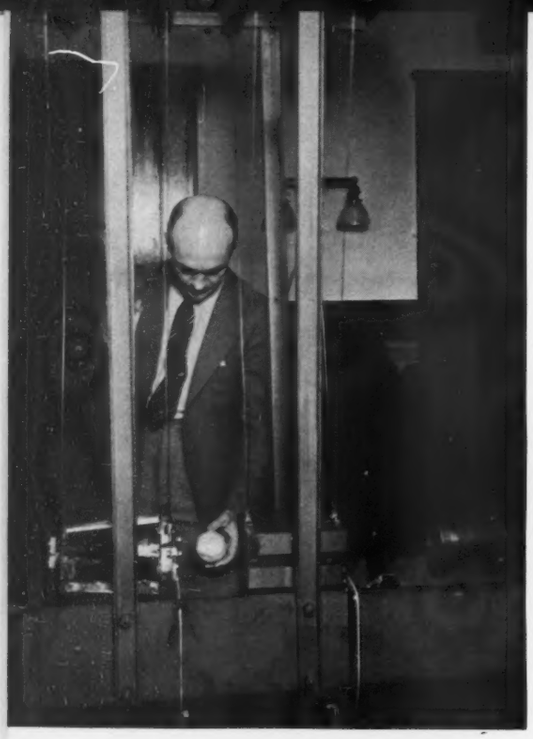
Air drying completes the cycle. Once more the timer does its appointed work: it shuts down the rinse pump and again actuates the solenoid that turns on the compressed-air supply. The air used for this purpose is taken direct from the compressor because it was found that it contains less moisture than preheated air and therefore facilitates drying. The same piping that has served for the previous operations delivers the compressed air and circulates it—the siphon stimulating the movement inside the package by continuously withdrawing the air as it absorbs the moisture until the surfaces are thoroughly dry. With that done, the timer closes the solenoid and puts out the signal light, a warning to the operator that the machine has completed its work. He opens the door and removes the container, which is now ready for the finishing department. The next package in the line of used drums is placed on the runway in the cleaning chamber; the other preliminary operations are repeated; and production continues automatically. In the interval the machine requires no attention, and the man in charge is free either to look after other similar units or to do any incidental job in the department.

The Portco, as the accompanying pictures show, is amazingly simple in design considering the manysided work it performs. It does everying but free the barrels and drums of rust, take out the dents, and spray on the paint, all but the first of which can be done expeditiously with the help of compressed air. For domestic use, the equipment is shipped assembled, ready to make the necessary drain, water, steam, compressed-air, and power connections. Special foundations are not needed: the units can be placed right on the floor, using a low platform to feed the containers, or they can be set up in a pit so that the charging door is level with the floor. Where the state of the containers is such as to demand it, the machines can be made explosion-proof, and this, together with the fact that all fumes and moisture are confined within the reconditioning chamber, assures safe and clean working conditions at all times.

WORK BEGINS WHEN DOOR SHUTS

Robot Batter Tests Major League Baseballs

G. H. Dacy



NEVER STRIKES OUT

The man is holding a baseball between the two ballistic pendulums of the mechanical batsman. At the extreme right is the cylinder from which both the baseball and the simulated bat are shot by compressed air. The ball passes through the first frame and is caught in the second one, which contains recording apparatus to time its flight. The hardwood projectile, being larger than the ball, is stopped by the first frame.

AS EVERY baseball "fan" knows, there are in the United States two major professional leagues, the National and American, each composed of eight teams. Although they are ostensibly on a parity, it has been noticeable for a considerable period that the American League representative in the annual World Series, played between the first-place teams of the respective leagues at the conclusion of their regular schedules, is preponderantly the winner. It has been equally apparent that the American League seemingly has the more consistent and longer-range hitters.

Various reasons have been advanced by advocates of the National League in explaining the comparative weakness of its batters. One of these is that the National League pitchers are more effective than those in the American League. But that argument loses force in the face of the impotence of these same pitchers against American League batters during World Series games. A second and more general attempt at explanation is the claim that the baseball used by the American League is livelier than that used by the National League, and that it goes faster and farther in consequence when hit solidly.

The baseballs are manufactured to specifications drawn up by the respective league officials. These specifications are not given to the public in detail, although an announcement is usually made when changes are put into effect. Most Americans like to see a generous proportion of long hits, and it is generally conceded that the league officials, with an eye to attendance, have altered the resilience of the ball in recent years to achieve this. At the same time, the turnstiles at the park entrances turn less often when games become too free-hitting. Therefore, the problem of the team owners is to put enough life in the ball so that it will travel fast and far when struck correctly, but not to overdo it to the point where the pitchers are made to look ineffective.

Arguments over the differences between the balls used in the two leagues have waxed long and loud, despite the repeated assertions of the officials that the balls are essentially equal in resiliency. Perhaps even the club owners began to have their doubts about this, however, for last spring it was decided to conduct scientific tests that would put an end to the controversy.

The U. S. Bureau of Standards was asked to direct the tests and to report its findings. To do these things it was necessary to design a mechanism that would strike the ball a blow in such a way as to simulate the natural action of a batter. It was essential that the blow delivered should be subject to control, and also that means should be available for accurately measuring the force of the blow. To meet these requirements, the Bureau engineers devised the robot batter shown in one of the accompanying illustrations. It consists in the main of a cylinder with a compressed-air actuated piston in front of which is placed a hardwood cylindrical projectile weighing approximately one pound. This projectile is literally shot against the ball, and, with air at 60 to 80 pounds pressure, imparts to it an initial maximum velocity of 200 feet a second. Thus driven, the ball passes through a frame, suspended like a pendulum, and is caught in a second suspended ballistic pendulum that also serves as a recording apparatus. Being larger than the ball, the wood "bat" is caught in the first pendulum. The ball travels only a few feet, but that distance is sufficient for the delicately adjusted mechanism to time its flight. From the time interval thus determined, the velocity and the carrying power of the ball can be computed.

It was important that the force of the impact should be the same as that resulting when the more expert batters strike a ball with a bat. As a check on this point, the mechanical batsman was taken to the playing park of the Washington American League Club, where, with its pendulums removed, it was set up at the home plate and the air pressure adjusted so that it would shoot long drives to distant parts of the grounds.

In both the indoor and outdoor tests it was determined that there is no significant variation in the resiliency of the balls used by the two leagues. Some National League balls proved to be livelier than some American League balls, and vice versa. These differences were no more pronounced, however, than the differences between balls made for the same league. Similarly, it was found that there are minute variations in weight within the official limits of 5 to 5¼ ounces, as well as slight differences in the circumference within the permissible range of 9 to 9¼ inches.

By varying the air pressure, the scientists conclusively proved something that expert batters have always contended—namely, that it is not the heaviness of the blow alone that causes the ball to soar long distances. Accomplished batters hit the ball with a comparatively light impact; they attain distance by timing the blow precisely, by following through with the stroke or swing, and by getting the power of their shoulders and body weight behind the bat at the instant of impact. After a certain point is reached, liveliness of the ball decreases, and its deformation increases in proportion to the severity of the impact.

In the outdoor tests, with the air gun adjusted to the range of good batters, it was established that both National and American League balls covered the same average distance of 367 feet. Individual balls traveled from 320 to 410 feet, the variations being attributed to fluctuations in the wind. As an additional check, the Bureau of Standards technicians took from each league a dozen balls and cut them through the middle so that they might determine how they were manufactured and test the materials used in their construction. This research failed to indicate that one ball was superior to the other.

Actual results obtained during the early stages of the 1938 season have more or less borne out these findings. In reality, the National League, playing with what is supposed to be a relatively "deader" ball than it did last year, scored one home run for every 56 times a man batted, as against one every 72.58 times at bat during the corresponding period in 1937. The American League, using the same kind of ball as it did a year ago, required on an average 64.8 times at bat to get a home run. This was 8.8 times more at bat than the National League, despite the fact that the American League ball is popularly believed to be the livelier of the two.

SAFETY AND PROFITS

THE humanitarian aspects of the practice of safety in industry are, of course, sufficient to justify the exercise of continual care and vigilance. Human lives and limbs cannot be appraised in terms of dollars alone, and the greatest compensation that can be received for safeguarding them is recorded in the heart rather than in the pocketbook.

Nevertheless, there definitely is a practical side to safety of which large employers of labor are well aware. In some quasi-public industries, of which common carriers of passengers are the leading examples, a diligent regard for the well-being of patrons is vital to profitable operations. Thirty or 40 years ago a certain railroad, whose lines traversed a mountainous area of the West, had such a bad reputation for wrecks and derailments that ticket sellers more or less openly urged each purchaser to buy accident insurance covering the duration of the trip. That was before automobiles were numerous and people had to travel that particular railroad to reach important mining camps quickly. Today the same railroad, operating virtually the same lines, is as safe as any in the country. Right of way, signal systems, and rolling stock are maintained in trustworthy condition despite the fact that the road is sorely beset by financial difficulties.

Throughout the country as a whole, railroad accidents that involve passengers are so rare that many prudent persons regularly use trains for business and pleasure trips of any length rather than subject themselves to the hazards of driving an automobile over heavily traveled highways. The "Safety First" signs on railroad structures have become so familiar that their absence would undoubtedly be generally noticed if they were suddenly to be removed.

In lesser degree than in the field of transportation, but just as certainly, safety pays monetary rewards to industrial concerns in general. In a recently published article, Col. John Stillwell, vice-president of the Consolidated Edison Company of New York, has revealed that his concern, by reducing its accident frequency rate per 100 employees from 20.14 to 8.11 during the past eleven years, has saved $2,785,087 in compensation and medical costs. Furthermore, it has been found that the emphasis placed on safety has caused the company's workers to observe greater caution when not at their work, and this has actually reduced home accidents by a considerable percentage.

It is also interesting to note the public services that are rendered by the Consolidated Edison Company as an outgrowth of its safety program. Artificial respirators, that are maintained primarily for resuscitating employees who may be overcome at their work, are held in readiness for any emergency within the Metropolitan area. There are eight units and 53 trained workers, and they now respond to more than 25,000 calls a year. In 1937 they were directly responsible for saving 850 lives; and in the 25 years that the service has been available more than 12,000 deaths have been averted.

TRENDS IN BUILDING CONSTRUCTION

IT IS generally admitted that a vigorous revival in building construction would go a long way towards improving and stabilizing economic conditions in the United States, and those that look for signs of business recovery keep an anxious eye on that industry. Particularly hopeful for the future would be a pronounced rise in residential building, and it is believed that the time when it must come is not far off. Confirmation of the soundness of this opinion is furnished by a study of the trend of construction since 1915, as recently made by the U. S. Department of Commerce.

This study went deeper into the subject than did preceding ones, and took cognizance of the underlying factors that influence the rise or fall of building construction of various kinds. One such influence that ordinarily is not taken into account is the present age distribution of our population. This is such as to indicate a large increase in families during the next decade or so, followed by a sharp decline.

During the period from 1921 to 1930, the number of new housing units started annually averaged 680,000. In 1934, the low point of 59,000 was reached, constituting an astounding decrease of more than 90 per cent. Three years later, 284,000 units were begun. While this was more than four times the 1934 total, still it was only 42 per cent of the 1921-1930 average. Thus a large backlog of residential building continues to pile up, and, with the population increasing annually, a house-building boom of considerable magnitude is inescapable in the near future.

The figures revealed by the governmental researchers emphasize the important contribution that the building construction industry makes in normal times towards economic stability. During its peak year, 1927, it accounted for expenditures of $14,000,000,000 for all classes of building. By 1933, this had declined to $4,000,000,000, the drop being equivalent to more than one and one-half times the national governmental budget. Between 1921 and 1930, approximately 3,000,000 workers were directly engaged in building activities, and an additional 3,500,000 were employed in connection with supplying materials to the building industry. Only agriculture and retail trade supported larger groups of the population.

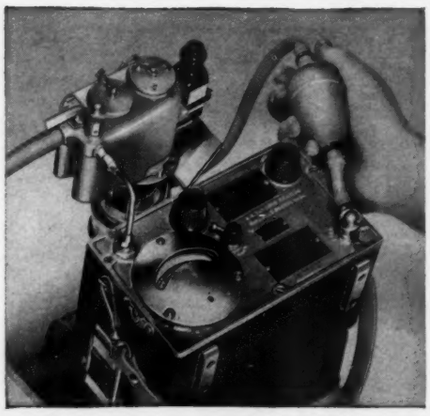
During the past twenty years, the construction of water works, parks and playgrounds, schools, and homes has been growing in importance in relation to total construction. It will be noted that this type of building provides facilities for consumer purposes as opposed to business and industrial purposes. Since 1929 there has been a distinct rise in the proportion of construction paid for with Federal funds. In 1927 it was only 2 per cent of the total, but in 1937 it had increased to 20 per cent.

Gas Detectors For Safety

"WORKER in manhole overcome by gas." "Fumes in ship's hold fells worker." Every now and then news items like this appear in the press and remind us of the hazards that confront men who are required for one reason or another to enter confined spaces in which explosive or irrespirable gas-air mixtures have a chance to accumulate. Fortunately, such accidents are now preventable and, as a rule, workers are no longer permitted to go down in sewers, conduits, manholes, oil-storage tanks, ships' holds, and kindred places until conditions are known to be safe. This can be determined by gas detectors such as those developed by The Linde Air Products Company. The latter makes three such instruments—the UCC Gas Indicators, as they are called—which, with the exception of the methane detector, are new.

Model 12-B is designed for recording combustible gases or vapors. It has a graduated meter scale which indicates by direct reading whether combustible gases are present and, if they are, whether the concentrations are below, within, or above explosive limits. If desired, the usefulness of this instrument can be increased by attaching to it a flame-type safety lamp which grows dim or is extinguished when the atmosphere tested does not contain sufficient oxygen to sustain life. Model B-1 is an all-service detector. Besides indicating combustible gases and a lack of oxygen, it also registers the presence of carbon monoxide and hydrogen sulphide in dangerously toxic concentrations.

Both instruments are provided with a patented 4-way valve by means of which incoming samples can be diluted with air in order that flammable conditions, which might otherwise remain unknown because of a lack of oxygen, can be determined. They are said to eliminate all guesswork in detecting explosive or irrespirable gases in confined areas, and to be invaluable in establishing purge-end points and in locating underground leaks.



PRECAUTIONARY MEASURES

At the right is a Model 12-B gas indicator with a safety lamp attached and as used in the routine testing of manholes. Above is the all-service detector.

Sanitary Collection of Refuse by Self-Loading Truck

WITH the development of a special self-loading truck by the Pneumatic Truck Body Corporation of Michigan, one important phase of municipal operations that has lagged far behind the times has apparently been put on a thoroughly modern basis. The new vehicle, called Pneutruck, is designed for the sanitary collection of ashes and garbage. It has an airtight body and is provided with a large-diameter intake hose made for the purpose by the United States Rubber Products, Inc. The hose is flexible to facilitate introduction into refuse cans, is reinforced with wire, and is resistant to fats, acids, and abrasion.

Loading is effected by suction induced by a centrifugal compressor-exhauster mounted between the cab and the truck. The unit is operated through the medium of what is known as a split propeller-shaft power take-off which, by the simple shifting of a lever, transfers the energy from the wheels to the exhauster. Power from the same source—the engine of the truck—is used for unloading, which is done without scattering by the conventional hydraulic end-dump method. All air entering the body through the hose with the refuse is filtered before it is discharged from a stack just back of the cab.

The rate of loading varies with the materials handled, including everything from ashes and cinders to metal filings and shavings, garbage, broken bottles, and tin cans. Normally, according to the builder, it takes about five seconds to empty a can with a capacity of 35 gallons; and empty means clean because of the strong vacuum pulled on the container. With two men, one for driving and the other to manipulate the hose—the same number normally required, the work of collecting garbage and ashes is not only speeded up by the use of the new vehicle but, what is of greater importance, is done hygienically. There is no spilling of the contents of cans during loading, and the trucks follow their routes without giving off noisome odors and leaving telltale trails behind them. Lifting of heavy containers is done away with to the relief of those who do the work as well as to the public, whose early morning slumbers are frequently disturbed in many communities by the clatter of metal refuse cans as the men of the sanitation department make their rounds.

Industrial Notes

An ultramicroscope has been invented, according to press reports, that, by the use of electron rays instead of ordinary light rays, magnifies 100,000 times, or 50 times as much as the familiar microscope. It is the product of the Siemens-Halske Company.

A hand-rotated, wet Stopehamer of improved design has been announced recently by Ingersoll-Rand Company. The outstanding feature of this new machine is the throttle valve, which represents a departure in rock-drill construction. It consists essentially of two perforated disks one of which is rotated by the throttle handle until the holes are in alignment, permitting a direct flow of air into the main valve. The latter is of the double-opening, direct-flow type that has been used with marked success for about a year in the company's new DA drifters. The throttle valve is held to its seat by air pressure which causes it to remain tight at all times, offsets wear, and prevents sticking. The direct result of this valve arrangement is said to be quick action, low air consumption, and high drilling speed. Another important feature is the fronthead, with its renewable bushing of alloy steel, which overlaps the cylinder to such an extent as to add measurably to the strength and rigidity of the entire drill. Further details about the SA-90 Stopehamer, as it is designated, are contained in Bulletin 2409, which can be obtained from the company's New York office, 11 Broadway, or any of its branches.

Of the 120 chromite deposits that are known to exist in Turkey, only one-fourth are being exploited at the present time. The Guleman district, which has an estimated monthly output of 5,000 tons, promises to become one of the world's most important chromite centers.

Russia, it has been reported, is producing synthetic rubies and sapphires on a commercial scale by a process developed by members of the All-Union Institute of Mineral Raw Materials. The stones are made of corundum, and are intended for use in jewelry, watches, precision instruments, etc.

Plastic Foil is said to protect blueprints, maps, documents, and reference papers generally against wear, deterioration, mold, and insect attack. It is a thermoplastic cellulose-acetate product 0.001 inch thick, and is applied to both sides by heat and pressure. The result is a homogeneous, flexible sheet that is as easy to read as it was originally, that will withstand handling, and that will resist aging.

Something new in flashlights is being made by the National Carbon Company. Designed to illuminate ordinarily inaccessible places, it is provided with a 13-inch flexible extension at the end of which is the electric bulb. The latter is protected by an unbreakable lens. Together with the housing, which contains two standard batteries, the flashlight is 19¾ inches long. It is not affected, it is said, by water, acids, grease, gasoline, etc.

For use in connection with certain of its spray guns, Binks Manufacturing Company has designed a 2-tube extension that permits a painter to reach ceilings and the upper parts of walls from the floor, thus doing away with scaffolding and step ladders. The twin tubes are attached to the air line and paint feed, respectively, are made of brass, and come in 6-, 8-, and 10-foot lengths.

Truck tires for use in factories where they are apt to come in contact with metal chips, grease, and oil are a new product of The B. F. Goodrich Company. The rubber of which they are made is specially compounded, and is said to be highly resistant to cutting and chipping, as well as to the harmful action of vegetable, animal, and mineral oils. The tires bear the trade name of Oil-Pruf.

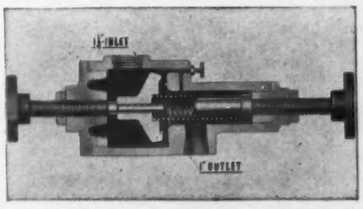
To keep out unauthorized persons and to maintain free circulation of the air is the dual purpose of the flexible steel curtain being manufactured by the Cornell Iron Works for garage doors, storage-bin openings, etc. It runs on an overhead track and has the appearance of a grille when spread apart. In the main, it consists of a galvanized chain-link meshwork suspended from rods, which vary in length according to requirements. The company carries in stock a curtain 10 feet wide and 12 feet high and makes special sizes to specifications.

Visitors to Washington, D. C., especially those interested in mining and metallurgy, should not overlook the new museum of the U. S. Department of the Interior that was opened to the public last March. A section of it is given over to the activities of the Bureau of Mines, and there are to be seen graphs, charts, pictures, models, specimens, and a diorama that illustrates what the Bureau is doing to safeguard the health and lives of miners, to conserve the country's mineral resources, and to reduce or to prevent waste in the mining industry. In addition, ingenious devices show some of the ways in which minerals enter into our daily lives. The exhibit is a permanent one, and is not only educational but also artistic.

Westinghouse Electric & Manufacturing Company is offering four new lubricants for use in connection with vacuum systems. There is No. 6 for glass stopcocks in lines that are subjected to high temperature; No. 7, which does not readily release gases that would interfere with readings, is intended for glass cocks in high-vacuum exhaust systems; No. 8 is recommended for oiling rubber hose connections to metal tips of vacuum exhaust pumps; and No. 10, which is of light consistency, is for general laboratory use.

In its Farmers' Bulletin No. 1786, the U. S. Department of Agriculture has given a very simple formula for a fireproofing solution for textiles that can be made at home and applied by dipping or with a common garden sprayer. It consists of 7 ounces of borax and 3 ounces of boric acid to 2 quarts of hot water. The mixture usually becomes thick if left standing, but can be made fluid again by warming it. The treatment is said to have little if any effect on the feel and appearance of curtains or other fabrics used for interior decorating and, aside from fireproofing them, protects them to a certain extent from the harmful action of acidic sulphur gases generally present in the air.

D. J. Murray Manufacturing Company has developed a safety valve for pipe lines carrying compressed air, gas, steam, or fluids under pressure. The valve, a longitudinal section of which is shown, shuts automatically whenever the line breaks anywhere beyond its outlet connection. It is provided with two threaded stems: one



to limit the valve opening, and the other, on the outlet side of the valve disk, to make adjustments through the medium of a spring—that is, to set the valve so that it will operate at any desired drop in pressure. There is an adjustable by-pass around the valve disk. This safety device, it is claimed, requires no attention once it is set: it closes of its own accord when the break occurs, and opens automatically as soon as repairs have been made and the pressure necessary to cause it to function has been built up on the outlet side.